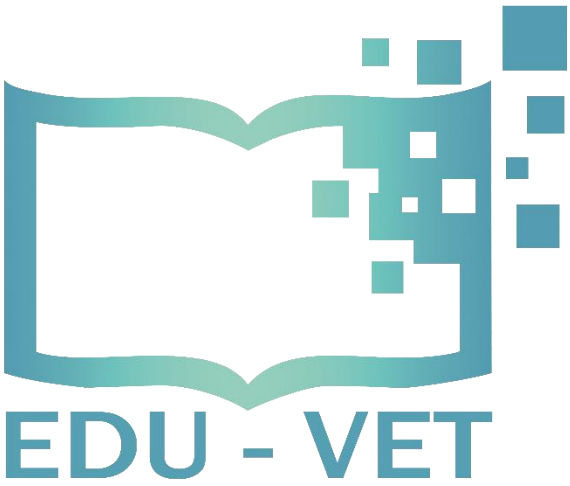
Marc Beutner / Rasmus Pechuel (Ed.)

E-Learning, Digitisation and Units for Learning at VET schools – Creating Online Learning Environments in Technical Education for European metal industry

New Opportunities and Challenges

for European VET schools in metal industry

Insights in the EDU-VET Project



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WP PADERBORN
Department Wirtschaftspädagogik
Business and Human Resource Education
Chair Wirtschaftspädagogik II

Ingenious Knowledge

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Abbreviations

BKBW	Berufskolleg Bocholt-West
BMBF	Bundesministerium für Bildung und Forschung - Federal Ministry of Education and Research
CIFP	Centro Integrado de Formación Profesional Someso
cf.	cited from
EDU-VET	Erasmus+ - project “E-Learning, Digitisation and Units for Learning at VET schools – Creating Online Learning Environments in Technical Education for European metal industry”
Ibid.	abbreviation for the Latin word ibīdem, meaning ´in the same place´
IK	Ingenious Knowledge
IO	Intellectual Output
IT	Information Technology
LMC	Lancaster and Morecambe College
Ltd.	Limited
LU	Learning Units
SBEOG	Stichting BVE Oost-Gelderland (Graafschap College)
UPB	University of Paderborn, Chair Business and Human Resource Education II
VET	Vocational Education and Training

Introduction

Marc Beutner

Digital transformation has influence on our daily life (BEUTNER / PECHUEL / SCHneider 2021). Accelerating economy and businesses it often transcends traditional roles of staff members, costumers but also learners. It is based on changes concerning aspects of culture, processes and technology as well as data requirements (see similar idea at DAVENPORT / REMAN 2020, p. 1) and it effects our society in different fields: e.g. economy, social interaction and education.

“Digital transformation and innovation in digitalization are boosted by consumers’ and investors’ expectations, as well as by prospects of greater economic and social benefits. Much of the literature claims that successful digital transformation comes not only from implementing new technologies, but also from transforming the organizations to take advantage of the possibilities that new technologies provide” (SCHILIRÒ 2020, p. 3).

With this book we will have a closer look at possibilities in the field of digital education as it is provided within the EDU-VET project which focuses education for metal industry.

A core aspect is the fact that digital education “is all about using digital technologies and tools in an innovative manner to teach and learn” (SKOOLBEEP 2022, p 1.).

The Digital Education Action Plan of the European Commission states that the “education and training system is increasingly part of the digital transformation and can harness its benefits and opportunities” (EUROPEAN COMMISSION 2020, p. 2).

The Commission points out that:

“Transforming education for the digital age is a task for the whole society. […] Digital education should play a pivotal role in increasing equality and inclusiveness. […] Digital competence should be a core skill for all educators and training staff” (EUROPEAN COMMISSION 2020, p. 8).

One of the most crucial aspects addressed by the Commission in its digital action plan is the fact that:

“Digital literacy is essential for life in a digitalised world“ (EUROPEAN COMMISSION 2020, p. 9) and the idea that

“Being digitally skilled and acquiring digital literacy can empower people of all ages to be more resilient, improve participation in democratic life and stay safe and secure online” (EUROPEAN COMMISSION 2020, p. 12).

Moreover, the Commission adds:

“In addition to digital skills, the digital economy requires also complementary skills such as adaptability, communication and collaboration skills, problem-solving, critical thinking, creativity, entrepreneurship and readiness to learn” (EUROPEAN COMMISSION 2020, p. 12).

Taking this into account EDU-VET decided to adjust eLearning in the field of metal works to the current needs and opportunities of digital education. New processes as well as technical and personal skills are gaining in importance in this sector. Today's students need to be prepared for more flexible forms of work and with regard to EDU-VET of metal work. Leaners face a more flexible labour market. This also leads to more mobility and dynamic work biographies. This also means that the metal sector needs educational resources that can be adjusted to varying contexts. Integrating different competence levels offers opportunities to accelerate reskilling and upskilling in personalised learning processes. KASRAIE / KASRAIE define eLearning very general “as learning facilitated through electronic means” (KASRAIE / KASRAIE 2010, p. 57).

Other authors focus more on the aspect of pedagogy and didactics which is needed to deal with elearning but highlight the technology aspect within. For example, TIRADE ET AL. define elearing as "pedagogy empowered by digital technology” (TITRADE, EL BAABOUA, SION, & MIHALCESCU, 2009).

A specific aspect of eLearning can be found in the processes in which digital technologies are used by educators to design pedagogic fruitful and engaging learning environments. In EDU-VET the focus of eLearning is set with regard to blended learning approaches which are fostered by a learning platform with courses designed with regard to different competence levels. Blended learning approaches can be offered by different models of types. In EDU-VET we offer opportunities to use our developed course system within the different approaches based on the types of blended learning addressed by STAKER and HORN.

Blended approaches are a mixture of face-to-face learning and digital learning which today often takes place online. Often a core idea is to combine inquiry-based learning, self-directed learning and social learning (see e.g. TEACHTHOUGHT STAFF / OLSEN 2013).

Already in 2012 STAKER and HORN offered an overview on types of blended learning and differentiated between (a) rotation models, like the station-rotation model, the lab-rotation

model, the flipped-classroom model and the individual-rotation model, (b) the flex model, (c) the self-blend model and (d) the enriched-virtual model (STAKER / HORN 2012, p. 2).

They describe a rotation model as "a program in which within a given course or subject (e.g., math), students rotate on a fixed schedule or at the teacher's discretion between learning modalities, at least one of which is online learning." (STAKER / HORN 2012, p. 8). The flex model is "a program in which content and instruction are delivered primarily by the Internet, students move on an individually customized, fluid schedule among learning modalities, and the teacher-of-record is on-site" (STAKER / HORN 2012, p. 12).

Moreover, the self-blend model "describes a scenario in which students choose to take one or more courses entirely online to supplement their traditional courses and the teacher-of-record is the online teacher" (STAKER / HORN 2012, p. 14).

And the enriched-virtual model is seen as a "a whole-school experience in which within each course (e.g. math), students divide their time between attending a brick-and-mortar campus and learning remotely using online delivery of content and instruction" (STAKER / HORN 2012, p. 15).

The goal of blended learning and also of the EDU-VET project is not to replace conventional learning styles or environments. We rather look for possibilities to incorporate useful opportunities and to complement face-to-face and online learning activities. The core idea is to foster the learners and support personalized the educational paths for learners.

This recognises a crucial aspect raised by European Parliamentary Research Service with regard to the fields of education addressed by the CEDEFOP:

"For the field of education, defined as encompassing school education, vocational training and higher education (CEDEFOP 2019[…]), this implies that facts no longer have to be learned by heart – instead, they can beimmediately accessed using mobile devices" (EUROPEAN PARLIAMENTARY RESEARCH SERVICE 2020, p.1).

Digital education offers the chance to rethink traditional learning process and to integrate aspects of the transformation process which happens in economy and our daily life also in education. This goes hand in hand with new option to make education more mobile, engaging, and interactive.

Marc Beutner
Paderborn, February 2022

Einführung

Die digitale Transformation beeinflusst maßgeblich unser tägliches Leben (BEUTNER / PECHUEL / SCHNEIDER 2021). Sie beschleunigt die Wirtschaft und die Unternehmen und geht oft über die traditionellen Rollen von Mitarbeitern, Kunden, aber auch Lernenden hinaus. Sie basiert auf Veränderungen in Bezug auf kulturelle, prozessuale und technologische Aspekte sowie auf Datenanforderungen (in Anlehnung an DAVENPORT / REMAN 2020, S. 1) und wirkt sich auf unsere Gesellschaft in verschiedenen Bereichen aus: z. B. Wirtschaft, soziale Interaktion und Bildung.

„Die digitale Transformation und die Innovation im Bereich der Digitalisierung werden durch die Erwartungen der Verbraucher und Investoren sowie durch die Aussicht auf größere wirtschaftliche und soziale Vorteile gefördert. In einem Großteil der Literatur wird behauptet, dass eine erfolgreiche digitale Transformation nicht nur aus der Implementierung neuer Technologien resultiert, sondern auch aus der Umgestaltung der Organisationen, um die Möglichkeiten zu nutzen, die die neuen Technologien bieten" (SCHILIRÒ 2020, S. 3).

Mit diesem Buch werden wir einen genaueren Blick auf die Möglichkeiten im Bereich der digitalen Bildung werfen, wie sie im Rahmen des EDU-VET-Projekts angeboten werden, das sich auf die Ausbildung für die Metallindustrie konzentriert.

Ein zentraler Aspekt ist die Tatsache, dass es bei der digitalen Bildung „darum geht, digitale Technologien und Werkzeuge auf innovative Weise für das Lehren und Lernen einzusetzen" (SKOOLBEEP 2022, S 1).

Im Aktionsplan für digitale Bildung der Europäischen Kommission heißt es, dass „das System der allgemeinen und beruflichen Bildung zunehmend Teil des digitalen Wandels ist und dessen Vorteile und Chancen nutzen kann" (EUROPEAN COMMISSION 2020, S. 2)

Die Kommission pointiert:

„Die Umgestaltung der Bildung für das digitale Zeitalter ist eine Aufgabe für die gesamte Gesellschaft. [...] Die digitale Bildung sollte eine zentrale Rolle bei der Förderung von Gleichheit und Inklusion spielen. [...] Digitale Kompetenz sollte eine Kernkompetenz für alle Pädagogen und Lehrkräfte sein" (EUROPEAN COMMISSION 2020, S. 8).

Einer der wichtigsten Aspekte, den die Kommission in ihrem digitalen Aktionsplan anspricht, ist die Tatsache, dass:

„Digitale Kompetenz ist für das Leben in einer digitalisierten Welt unerlässlich“ (EUROPEAN COMMISSION 2020, S. 9) und die Idee, dass

„Digitale Kompetenz und der Erwerb digitaler Fähigkeiten können Menschen aller Altersgruppen in die Lage versetzen, widerstandsfähiger zu sein, sich besser am demokratischen Leben zu beteiligen und im Internet sicher zu sein” (EUROPEAN COMMISSION 2020, S. 12).

Ergänzend fügt die Kommission hinzu:

„Die digitale Wirtschaft erfordert nicht nur digitale Fähigkeiten, sondern auch ergänzende Fähigkeiten wie Anpassungsfähigkeit, Kommunikations- und Kooperationsfähigkeit, Problemlösungsfähigkeit, kritisches Denken, Kreativität, Unternehmergeist und Lernbereitschaft” (EUROPEAN COMMISSION 2020, S. 12).

Vor diesem Hintergrund hat EDU-VET beschlossen, das E-Learning im Bereich der Metallverarbeitung an die aktuellen Bedürfnisse und Möglichkeiten der digitalen Bildung anzupassen. Neue Prozesse sowie technische und persönliche Fähigkeiten gewinnen in diesem Sektor zunehmend an Bedeutung. Die Schüler von heute müssen auf flexiblere Arbeitsformen vorbereitet werden, auch im Hinblick auf EDU-VET und der Metallbranche. Die Lernenden sind mit einem flexibleren Arbeitsmarkt konfrontiert. Dies führt auch zu mehr Mobilität und dynamischen Arbeitsbiographien. Dies bedeutet auch, dass der Metallsektor Bildungsressourcen benötigt, die an unterschiedliche Kontexte angepasst werden können. Die Integration verschiedener Kompetenzniveaus bietet Möglichkeiten, die Umschulung und Höherqualifizierung in personalisierten Lernprozessen zu beschleunigen. KASRAIE / KASRAIE definieren E-Learning ganz allgemein „als Lernen, das durch elektronische Mittel ermöglicht wird” (KASRAIE / KASRAIE 2010, S. 57).

Andere Autoren konzentrieren sich mehr auf den Aspekt der Pädagogik und Didaktik, der für den Umgang mit E-Learning erforderlich ist, betonen aber auch den technologischen Aspekt darin. Zum Beispiel definieren TITRADE ET AL. E-Learning als „Pädagogik, die durch digitale Technologie gestärkt wird“ (TITRADE / EL BAABOUA / SION & MIHALCESCU 2009).

Ein spezifischer Aspekt des E-Learning liegt in den Prozessen, in denen digitale Technologien von Pädagogen genutzt werden, um pädagogisch fruchtbare und ansprechende Lernumgebungen zu gestalten. In der beruflichen Bildung liegt der Schwerpunkt des E-Learning auf Blended-Learning-Ansätzen, die durch eine Lernplattform mit Kursen auf verschiedenen Kompetenzniveaus gefördert werden. Blended-Learning-Ansätze können in

verschiedenen Modellen angeboten werden. In EDU-VET bieten wir Möglichkeiten, unser entwickeltes Kurssystem innerhalb der verschiedenen Ansätze zu nutzen, basierend auf den Typen des Blended Learning, die von STAKER and HORN.

Blended Learning-Ansätze sind eine Mischung aus persönlichem Lernen und digitalem Lernen, das heute oft online stattfindet. Ein Kerngedanke ist oft, forschendes Lernen, selbstgesteuertes Lernen und soziales Lernen zu kombinieren (siehe u. a. TEACHTHOUGHT STAFF / OLSEN 2013)

Bereits 2012 gaben STAKER und HORN einen Überblick über die Arten des Blended Learning und unterschieden zwischen (a) Rotationsmodellen, wie dem Stations-Rotations-Modell, dem Labor-Rotations-Modell, dem Flipped-Classroom-Modell und dem Individual-Rotations-Modell, (b) dem Flex-Modell, (c) dem Self-Blend-Modell und (d) dem Enriched-Virtual-Modell (STAKER / HORN 2012, S. 2).

Sie beschreiben ein Rotationsmodell als „ein Programm, bei dem die Schüler innerhalb eines bestimmten Kurses oder Faches (z. B. Mathematik) nach einem festen Zeitplan oder nach Ermessen des Lehrers zwischen verschiedenen Lernmodalitäten wechseln, von denen mindestens eine das Online-Lernen ist“ (STAKER / HORN 2012, S. 8).
Das Flex-Modell ist „ein Programm, bei dem Inhalte und Unterricht hauptsächlich über das Internet vermittelt werden, die Studierenden nach einem individuell angepassten, fließenden Zeitplan zwischen den Lernmodalitäten wechseln und der Lehrer vor Ort ist” (STAKER / HORN 2012, S. 12).

Darüber hinaus beschreibt das Modell der Selbstmischung „ein Szenario, in dem die Studierenden sich dafür entscheiden, einen oder mehrere Kurse vollständig online zu belegen, um ihre traditionellen Kurse zu ergänzen, und der Lehrende, der die Unterlagen ausstellt, ist der Online-Lehrer” (STAKER / HORN 2012, S. 14).

Letztlich wird das Enriched-Virtual-Modell als „eine ganzheitliche Schulerfahrung gesehen, bei der die Schüler innerhalb eines Kurses (z. B. Mathematik) ihre Zeit zwischen der Teilnahme an einem stationären Campus und dem Lernen aus der Ferne durch die Online-Bereitstellung von Inhalten und Unterricht aufteilen“ (STAKER / HORN 2012, S. 15).

Das Ziel von Blended Learning und auch des EDU-VET-Projekts ist es nicht, herkömmliche Lernformen oder -umgebungen zu ersetzen. Vielmehr suchen wir nach Möglichkeiten, sinnvolle Angebote einzubinden und Präsenz- und Online-Lernaktivitäten zu ergänzen. Der Kerngedanke ist, die Lernenden zu fördern und personalisierte Bildungswege für die Lernenden zu unterstützen.

Damit wird ein entscheidender Aspekt anerkannt, den der Forschungsdienst des Europäischen Parlaments in Bezug auf die vom CEDEFOP behandelten Bildungsbereiche bereits angesprochen hat:

„Für den Bildungsbereich, der Schulbildung, Berufsbildung und Hochschulbildung umfasst (CEDEFOP 2019[...]), bedeutet dies, dass Fakten nicht mehr auswendig gelernt werden müssen, sondern über mobile Geräte sofort abrufbar sind" (EUROPEAN PARLIAMENTARY RESEARCH SERVICE 2020, S. 1).

Die digitale Bildung bietet die Chance, den traditionellen Lernprozess zu überdenken und Aspekte des Transformationsprozesses, der in der Wirtschaft und in unserem täglichen Leben stattfindet, auch in die Bildung zu integrieren. Dies geht Hand in Hand mit neuen Möglichkeiten, Bildung mobiler, ansprechender und interaktiver zu gestalten.

Marc Beutner
Paderborn, Februar 2022

Inleiding

Digitale transformatie heeft invloed op ons dagelijks leven (BEUTNER / PECHUEL / SCHNEIDER 2021). De economie en het bedrijfsleven versnellen, hierdoor overstijgt het vaak de traditionele rollen van medewerkers, klanten maar ook lerenden. Het is gebaseerd op veranderingen met betrekking tot aspecten van cultuur, processen en technologie, evenals gegevensvereisten (zie vergelijkbaar idee in DAVENPORT / REMAN 2020, p. 1) en het beïnvloedt onze samenleving op verschillende gebieden: bijv. economie, sociale interactie en onderwijs.

"Digitale transformatie en innovatie in digitalisering worden gestimuleerd door de verwachtingen van consumenten en investeerders, en door vooruitzichten op grotere economische en sociale voordelen. Veel literatuur beweert dat succesvolle digitale transformatie niet alleen voortkomt uit het implementeren van nieuwe technologieën, maar ook uit het transformeren van organisaties om te profiteren van de mogelijkheden die nieuwe technologieën bieden" (SCHILIRÒ 2020, p. 3).

Met dit boek gaan we dieper in op de mogelijkheden op het gebied van digitaal onderwijs zoals dat wordt aangeboden binnen het EDU-VET-project dat zich richt op onderwijs voor de metaalindustrie.

Een kernaspect is het feit dat digitaal onderwijs "allemaal draait om het gebruik van digitale technologieën en hulpmiddelen op een innovatieve manier om te onderwijzen en leren" (SKOOLBEEP 2022, p 1.).

Het actieplan voor digitaal onderwijs van de Europese Commissie stelt dat het "onderwijs- en opleidingssysteem steeds meer deel uitmaakt van de digitale transformatie en de voordelen en kansen ervan kan benutten" (EUROPESE COMMISSIE 2020, p. 2).

De Commissie wijst erop dat:

"Het onderwijs transformeren voor het digitale tijdperk een taak is voor de hele samenleving. […] Digitaal onderwijs moet een centrale rol spelen bij het vergroten van gelijkheid en inclusiviteit. […] Digitale competentie moet een kernvaardigheid zijn voor alle docenten en trainingspersoneel" (EUROPESE COMMISSIE 2020, p. 8).

Een van de meest cruciale aspecten die de Commissie in haar digitale actieplan aan de orde stelt, is het feit dat:

"Digitale geletterdheid is essentieel voor het leven in een gedigitaliseerde wereld" (EUROPESE COMMISSIE 2020, p. 9) en het idee dat

“Digitaal vaardig zijn en digitale geletterdheid verwerven, kan mensen van alle leeftijden in staat stellen veerkrachtiger te zijn, de deelname aan het democratisch leven te verbeteren en online veilig en beveiligd te blijven” (EUROPESE COMMISSIE 2020, p. 12).

Bovendien voegt de Commissie eraan toe:

“Naast digitale vaardigheden vereist de digitale economie ook complementaire vaardigheden zoals aanpassingsvermogen, communicatie- en samenwerkingsvaardigheden, probleemoplossend vermogen, kritisch denken, creativiteit, ondernemerschap en bereidheid om te leren” (EUROPESE COMMISSIE 2020, p. 12).

Hiermee rekening houdend heeft EDU-VET besloten om E-learning op het gebied van metaalbewerking aan te passen aan de huidige behoeften en kansen van digitaal onderwijs. Nieuwe processen, en technische en persoonlijke vaardigheden winnen in deze sector aan belang. De studenten van nu moeten voorbereid zijn op flexibelere vormen van werk en met betrekking tot EDU-VET metaalbewerking. Lerenden hebben te maken met een flexibelere arbeidsmarkt. Dit leidt ook tot meer mobiliteit en dynamische werkbiografieën. Dit betekent ook dat de metaalsector educatieve middelen nodig heeft die kunnen worden aangepast aan verschillende contexten. Het integreren van verschillende competentieniveaus biedt kansen om om- en bijscholing in gepersonaliseerde leerprocessen te versnellen. KASRAIE/KASRAIE definiëren E-learning zeer algemeen “als leren dat wordt gefaciliteerd door elektronische middelen” (KASRAIE/KASRAIE 2010, p. 57).

Andere auteurs richten zich meer op het aspect pedagogiek en didactiek dat nodig is om met E-learning om te gaan, maar benadrukken het technologische aspect erin. TITRADE ET AL. definieer E-learning bijvoorbeeld als “pedagogie ondersteund door digitale technologie” (TITRADE, EL BAABOUA, SION, & MIHALCESCU, 2009).

Een specifiek aspect van E-learning is te vinden in de processen waarin digitale technologieën door docenten worden gebruikt om pedagogisch vruchtbare en boeiende leeromgevingen te ontwerpen. In EDU-VET ligt de focus van E-learning op blended learning-benaderingen die worden bevorderd door een leerplatform met cursussen die zijn ontworpen met betrekking tot verschillende competentieniveaus. Blended learning-benaderingen kunnen worden aangeboden door verschillende modelsoorten. In EDU-VET bieden we mogelijkheden om ons ontwikkelde cursussysteem te gebruiken binnen de verschillende benaderingen op basis van de soorten blended learning die door STAKER en HORN worden aangepakt.

Blended-benaderingen zijn een mix van in persoon leren en digitaal leren, dat tegenwoordig vaak online plaatsvindt. Vaak is een kernidee het combineren van onderzoekend leren, zelfgestuurd leren en sociaal leren (zie bijv. TEACHTHOUGHT STAFF / OLLSEN 2013).

Reeds in 2012 boden Staker en Horn een overzicht van vormen van blended learning en maakten onderscheid tussen (a) rotatiemodellen, zoals het station-rotatiemodel, het laboratorium-rotatiemodel, het omgedraaid klaslokaal-model en het individuele rotatiemodel, (b) het flex-model, (c) het self-blend-model en (d) het verrijkt-virtuele model (STAKER / HORN 2012, p. 2).

Ze beschrijven een rotatiemodel als

“een programma waarin studenten binnen een bepaalde cursus of een bepaald vak (bijvoorbeeld wiskunde) volgens een vast schema of naar goeddunken van de leraar wisselen tussen leermodaliteiten, waarvan ten minste één online leren is” (STAKER / HORN 2012, p. 8). Het flex-model is “een programma waarin inhoud en instructie voornamelijk via internet worden geleverd, studenten zich verplaatsen volgens een individueel aangepast, vloeiend schema tussen leermodaliteiten, en de hoofddocent is op locatie” (STAKER / HORN 2012, p. 12).

Bovendien beschrijft het self-blend-model “een scenario waarin studenten ervoor kiezen om een of meer cursussen volledig online te volgen als aanvulling op hun traditionele cursussen en de hoofddocent de online leraar is” (STAKER / HORN 2012, p. 14).

En het verrijkte virtuele model wordt gezien als een “schoolbrede ervaring waarin studenten binnen elke cursus (bijv. wiskunde) hun tijd verdelen tussen het bijwonen van een fysieke campus en leren op afstand met behulp van online levering van inhoud en instructies” (STAKER / HORN 2012, p. 15).

Het doel van blended learning en ook van het EDU-VET-project is niet om conventionele leerstijlen of -omgevingen te vervangen. We zoeken eerder naar mogelijkheden om nuttige kansen te integreren en om in persoon en online leeractiviteiten aan te vullen. Het kernidee is om de lerenden te stimuleren en de leertrajecten voor lerenden op maat te ondersteunen.

Dit erkent een cruciaal aspect dat door de Onderzoeksdienst van het Europees Parlement naar voren is gebracht met betrekking tot de onderwijsgebieden die door het CEDEFOP worden behandeld:

“Voor het onderwijsgebied, gedefinieerd als schoolonderwijs, beroepsopleiding en hoger onderwijs (CEDEFOP 2019[…]), betekent dit dat feiten niet langer uit het hoofd hoeven te

worden geleerd, maar dat ze onmiddellijk toegankelijk zijn met mobiele apparaten." (ONDERZOEKSDIENST VAN HET EUROPEES PARLEMENT 2020, p.1)

Digitaal onderwijs biedt de kans om het traditionele leerproces te heroverwegen en om aspecten van het transformatieproces dat plaatsvindt in de economie en ons dagelijks leven ook in het onderwijs te integreren. Dit gaat hand in hand met een nieuwe optie om het onderwijs mobieler, boeiender en interactiever te maken.

Marc Beutner
Paderborn, Februari 2022

Prefacio

La transformación digital influye en nuestra vida cotidiana (BEUTNER / PECHUEL / SCHNEIDER 2021). La aceleración de la economía y los negocios a menudo trasciende los roles tradicionales de los miembros del personal, los clientes y también los alumnos. Se basa en cambios relativos a aspectos de la cultura, los procesos y la tecnología, así como a los requisitos de los datos (véase una idea similar en DAVENPORT / REMAN 2020, p. 1) y afecta a nuestra sociedad en diferentes ámbitos: por ejemplo, la economía, la interacción social y la educación.

"La transformación digital y la innovación en la digitalización están impulsadas por las expectativas de los consumidores y los inversores, así como por las perspectivas de mayores beneficios económicos y sociales. Gran parte de la bibliografía afirma que el éxito de la transformación digital no sólo proviene de la implementación de nuevas tecnologías, sino también de la transformación de las organizaciones para aprovechar las posibilidades que ofrecen las nuevas tecnologías." (SCHILIRÓ 2020, p. 3).

Con este libro vamos a ver más de cerca las posibilidades en el campo de la educación digital tal y como se ofrece dentro del proyecto EDU-VET, que se centra en la educación para la industria del metal.

Un aspecto fundamental es el hecho de que la educación digital "consiste en utilizar las tecnologías y herramientas digitales de forma innovadora para enseñar y aprender". (SKOOLBEEP 2022, p 1.)

El Plan de Acción de Educación Digital de la Comisión Europea afirma que el "sistema de educación y formación forma parte cada vez más de la transformación digital y puede aprovechar sus beneficios y oportunidades". (COMISIÓN EUROPEA 2020, p. 2)

La Comisión señala que:

"Transformar la educación para la era digital es una tarea de toda la sociedad. [...] La educación digital debe desempeñar un papel fundamental en el aumento de la igualdad y la inclusión. [...]

La competencia digital debería ser una habilidad fundamental para todos los educadores y el personal de formación" (COMISIÓN EUROPEA 2020, p. 8).

Uno de los aspectos más cruciales que aborda la Comisión en su plan de acción digital es el hecho de que

"La alfabetización digital es esencial para la vida en un mundo digitalizado" (COMISIÓN EUROPEA 2020, p. 9)

y la idea de que

"La capacitación digital y la adquisición de conocimientos digitales pueden capacitar a las personas de todas las edades para ser más resilientes, mejorar la participación en la vida democrática y mantenerse seguras online" (COMISIÓN EUROPEA 2020, p. 12).

Además, la Comisión añade

"Además de las competencias digitales, la economía digital requiere también competencias complementarias como la adaptabilidad, las capacidades de comunicación y colaboración, la resolución de problemas, el pensamiento crítico, la creatividad, el espíritu empresarial y la disposición a aprender" (COMISIÓN EUROPEA 2020, p. 12).

Teniendo esto en cuenta, EDU-VET decidió ajustar el eLearning en el ámbito de los trabajos del metal a las necesidades y oportunidades actuales de la educación digital. Los nuevos procesos, así como las habilidades técnicas y personales, están ganando en importancia en este sector. Los estudiantes de hoy en día necesitan estar preparados para formas de trabajo más flexibles y ahí es donde aparece EDU-VET en el sector del metal. Los estudiantes se enfrentan a un mercado laboral más flexible. Esto también conlleva una mayor movilidad y unas biografías laborales más dinámicas. Esto también significa que el sector del metal necesita recursos educativos que puedan ajustarse a los distintos contextos. La integración de diferentes niveles de competencia ofrece oportunidades para acelerar la recualificación y el perfeccionamiento en procesos de aprendizaje personalizados. KASRAIE / KASRAIE definen el eLearning de forma muy general "como el aprendizaje facilitado por medios electrónicos". (KASRAIE / KASRAIE 2010, p. 57)

Otros autores se centran más en el aspecto de la pedagogía y la didáctica que se necesita para abordar el elearning, pero destacan el aspecto de la tecnología en su interior. Por ejemplo, TITRADE ET AL. definen eLearning como "pedagogía potenciada por la tecnología digital" (TITRADE , EL BAABOUA, SION MIHALCESCU 2009).

Un aspecto específico del eLearning se encuentra en los procesos en los que los educadores utilizan las tecnologías digitales para diseñar entornos de aprendizaje pedagógicos, fructíferos y atractivos. En EDU-VET el enfoque del eLearning se establece en relación con los enfoques de aprendizaje semipresencial que se fomentan mediante una plataforma de aprendizaje con cursos diseñados en función a diferentes niveles de competencia. Los enfoques de aprendizaje

semipresencial son variados. En EDU-VET seguimos el enfoque basado en los tipos de aprendizaje semipresencial abordados por STAKER y HORN.

Los enfoques sempresenciales son una mezcla de aprendizaje presencial y aprendizaje digital que hoy en día suele tener lugar online. A menudo, una idea central es combinar el aprendizaje basado en la investigación, el aprendizaje autodirigido y el aprendizaje social (véase, por ejemplo, TEACHTHOUGHT STAFF / OLSEN 2013).

Ya en 2012 STAKER y HORN ofrecieron una visión general sobre los tipos de aprendizaje semipresencial y diferenciaron entre (a) los modelos de rotación, como el modelo de rotación por estaciones, el modelo de rotación por laboratorios, el modelo de aula invertida y el modelo de rotación individual, (b) el modelo flexible, (c) el modelo de auto-mezcla y (d) el modelo virtual-enriquecido (STAKER / HORN 2012, p. 2).

Describen un modelo de rotación como "un programa en el que dentro de un curso o asignatura determinada (por ejemplo, matemáticas), los estudiantes rotan en un horario fijo o a discreción del profesor entre modalidades de aprendizaje, al menos una de las cuales es el aprendizaje en línea" (STAKER / HORN 2012, p. 8).

El modelo flexible es "un programa en el que el contenido y las instrucciones se entregan principalmente por Internet, los estudiantes trabajan de acuerdo con un horario personalizado y fluido entre las diversas modalidades de aprendizaje, mientras que hay un profesor presente en el aula" (STAKER / HORN 2012, p. 12).

Por otra parte, el modelo de auto-mezcla "describe un escenario en el que los estudiantes eligen tomar uno o más cursos totalmente en línea para complementar sus cursos tradicionales mientras que hay un profesor online" (STAKER / HORN 2012, p. 14).

Y el modelo enriquecido-virtual es visto como una "experiencia de escuela completa en la que dentro de cada curso (por ejemplo, matemáticas), los estudiantes dividen su tiempo entre la asistencia a clases en un centro educativo y el aprendizaje a distancia utilizando la entrega online de contenidos e instrucciones" (STAKER / HORN 2012, p. 15).

El objetivo del aprendizaje semipresencial y también del proyecto EDU-VET no es sustituir los estilos o entornos de aprendizaje convencionales. Más bien buscamos posibilidades para incorporar oportunidades útiles y complementar las actividades de aprendizaje presenciales y online. La idea central es fomentar el aprendizaje y apoyar la personalización de las vías educativas de los alumnos.

Esto reconoce un aspecto crucial planteado por el Servicio de Investigación del Parlamento Europeo con respecto a los campos de la educación que aborda el CEDEFOP:

"Para el ámbito de la educación, que se define como el que abarca la educación escolar, la formación profesional y la educación superior (CEDEFOP 2019[...]), esto implica que los hechos ya no tienen que aprenderse de memoria, sino que se puede acceder a ellos inmediatamente mediante dispositivos móviles." (EUROPEAN PARLIAMENTARY RESEARCH SERVICE 2020, p.1)

La educación digital ofrece la oportunidad de repensar el proceso de aprendizaje tradicional y de integrar aspectos del proceso de transformación que se produce en la economía y en nuestra vida cotidiana también en la educación. Esto va de la mano de una nueva opción para hacer que la educación sea más móvil, atractiva e interactiva.

Marc Beutner
Paderborn, Febrero 2022

Part A – Digitisation and new media in the VET sector in Europe with reference to the metal industry – A first glance

1. Digitalisation and digital transformation in VET and the metal sector

Marc Beutner

These days, the European discussion on digitisation is not only focussing on economy. It is becoming a broader discussion which also addresses education and society. For example, the European Parliamentary Research Service – EPRS describe the changes with regard to digital transformation. In the EPRS report on "Rethinking education in the digital age" the first sentence of the introductory box before the core executive summary is:

"The digital transformation is changing the European economy and European society" (EUROPEAN PARLIAMENTARY RESEARCH SERVICE 2020, p. 1).

and the second paragraph starts with:

"Rethinking education in the digital age should become a central matter for today's policy-makers […]" (EUROPEAN PARLIAMENTARY RESEARCH SERVICE 2020, p. 1).

Anyway, this shows the importance of these ideas which are also mentioned in the digital strategy of the EU, where the European Commission already stated in 2018 that Europe is "at a crossroads in the development of the European Union. The medium-term challenges facing Europe include globalisation, climate change, demographics and digitalisation." (EUROPEAN COMMISSION 2018, p. 2).

Also, with the Digital Education Action Plan from 2020 the European Commission clarified that the "COVID-19 pandemic is impacting heavily on education and training systems. In highly difficult circumstances it has accelerated the digital transformation and triggered rapid, large-scale change" (EUROPEAN COMMISSION 2020, p. 19).

The Commission is also aware that to "thrive in a technology-driven economy, Europeans need digital skills" (EUROPEAN COMMISSION 2020, p. 13).

But this means that it has to be clarified as well, what is addressed when we are speaking about digitisation and digital transformation.

The most common view on digitisation means that it focuses on the change from analogue formats to digital data and formats (cf. BEUTNER 2019c, p. 5).

Regarding digital transformation digital solutions and processes to improve business, engineering, manufacturing and service come into focus. The idea is, to apply digital capabilities to processes but also to products to enhance efficiency, increase convenience, the ease of use, customer value. Moreover, concerning education digital transformation in education does not only focus on the provision of technical equipment but on the creation of engaging and effective education processes and the facilitation of learning and teaching on the basis of didactic and pedagogic approaches.

Within the research of the Digi-VET project (see BEUTNER / PECHUEL / SCHNEIDER 2021) we presented six different definitions which currently all exist in Europe to teachers, trainers and education providers. 425 particiants were involved – 96 from Cyprus, 115 from Germany, 111 from Romania and 103 from UK. These are the six defintions:

“Digitisation is the process of converting information into a digital (i.e. computer-readable) format.

Digitisation is the process of converting economic processes from an analogue to a digital way of work.

Digitisation is the process of digital change in society and the digital transformation which is recognized as the digital revolution. Digitisation the digital modification of instruments and tools. Digitisation means to compress data lossless or lossy. Digitisation means optimisation of Business processes using information technology” (BEUTNER 2019).

Some of these definitions are process related, some are more technical or IT-related and some are work-related.

Most of the participants were not able to recognise that all these definitions can be correct in different scenarios and are all.

In Germany for example only 39,1% of the respondents think that digitisation means to compress data lossless or lossy (see BEUTNER 2021, p. 227ff.).

However, there are also scientific definitions of digitisation. Burkett provided for example in 2017 a distinction between digitisation and digitalisation. According to this distinction digitisation can be interpreted as a process in which information is converted from a physical

format into a digital format and digitalisation addresses processes that lead to the improvement business processes (cf. BURKETT 2017 see similar BEUTNER 2019b, p. 19ff.).

TIMICO raised in 2018 with a very different focus, which looks at effects of IT the internet and the digital world on people and work (TIMICO 2018).

Digital transformation fundamentally changes an organisation with its culture, processes and technology in order to improve existing way of work. In 2019 GAO ET AL. focussed on digital transformation in the metal industry and investigated the challenges of transformation processes in this asset-intensive business (GAO / HAKANEN / TÖYTÄRI / RAJALA 2019, p. 4927ff.). According to their research metal industry was quite stable over years:

"To the date, the industry has enjoyed a long period of stability, which has encouraged the companies to focus on incremental operational improvements, rather on than radical, disruptive innovations" (GAO / HAKANEN / TÖYTÄRI / RAJALA 2019, p. 4929).

A core finding of Gao et al. was that "Digital transformation extends the scope of activities from the traditional manufacturing related activities to software business related activities, inducing a need to build or gain access to a whole range of novel capabilities and resources, and integrate those capabilities into a value creating activity system" (GAO / HAKANEN / TÖYTÄRI / RAJALA 2019, p. 4933).

Also, RALPH and STOCKINGER addressed aspects of digitalization and digital transformation in the metal sector especially with regard to metal forming. They recognise the fear of job loss due to disruptive technologies. Moreover, they pointed out that "companies in the metal forming industry are particularly affected by this development" (RALPH / STOCKINGER 2020, p. 1).

In addition, they pointed at some challenges like the fact that the metal forming industry is characterized by a high degree of heterogeneity (cf. RALPH / STOCKINGER 2020, p. 6). "It includes a variety of production processes, materials, machine systems, but also organizational structures and sizes" (RALPH / STOCKINGER 2020, p. 6).

With regard to the effect on education Ralph and Stocking state, that "in order to be able to meet the increasing demand for qualified specialists in the future from today's perspective, appropriate training and further training measures must be developed" (RALPH / STOCKINGER 2020, p. 8).

This is where the EDU-VET project comes into action and offers first solution to this challenging task.

With regard to the needed competences with regard to digital transformation Matti PIHALAJAMAA, Nando MELMELIN and Arto WALLIN from Finland pointed out that "digital transformation brings significant challenges for managing competences." (PIHALAJAMAA / MELMELIN / WALLIN 2021, p. 1).

With regard to management education they state that it is important act within three fields: (a) to develop new competencies, (b) to promote competence combination, and (c) to enhance transformational leadership (PIHALAJAMAA / MELMELIN / WALLIN 2021, p. 1).

According to PIGNI, PICCOLI and WATSON companies need to acquire competences which support their processes to exploit new technologies' opportunities (PIGNI / PICCOLI /WATSON 2016).

Dealing with digitisation and digital transformation means that all three, people, processes and technology have to be considered. Changes concerning or within processes may force staff members to acquire new skills and competences. The operating personnel who are using new technology, new software or new equipment have to be trained and an apprenticeship which already focusses on new technologies and takes them actively in account is a solid basis for such extensive further trainings. That´s way EDU-VET focuses at initial vocational training in the metal sector and integrates digital learning already at this early point of the vocational career. There is also a huge importance to qualify vocational trainers in metal industry because there "is a lack of didactic concepts for qualifying the heterogeneous target group of vocational training personnel" (EICKEMEIER / FRENZ / HANDL 2019, p. 123).

With regard to their focus on the work of FRENZ / HEINEN and SCHLICK (cf. FRENZ / HEINEN / SCHLICK 2012, p 12ff.) it can be found that "the advancing digitalization requires both new possibilities for shaping the world of vocational education and training and a corresponding qualification of the heterogeneous vocational training personnel" (EICKEMEIER / FRENZ / HANDL 2019, p. 123).

Also MEINHARD and FLAKe addressed digital transformation and eLearning in 2018 but with focus on initial and continuing VET of German companies. They pointed out that German companies have to adapt their VET activities to future skill sets. In addition to that, they see the need for structural changes German companies and also for the German dual VET system (MEINHARD / FLAKE 2018, p. 1057ff.)

As a result of digitisation processes new challenges can be found in the field of vocational education (cf. BEUTNER 2019b, p. 4; cf. KMK 2016, p. 3) and this goes hand in hand with increasing interaction and communication as I-SCOOP already stated in 2020 when they said:

> "Digitalization means turning interactions, communications, business functions and business models into (more) digital ones which often boils down to a mix of digital and physical as in omnichannel customer service, integrated marketing or smart manufacturing with a mix of autonomous, semi-autonomous and manual operations." (I-SCOOP 2020a)

In total it can be said that digital transformation triggers formation of new learning and teaching environments which focus on eLearning as well as on the creation of interactive learnings ecosystems. In the fields of digital learning and digital transformation a convergence of different aspects of life can be recognised. The COVID19 pandemic has not only changes ways of work and learning in companies but also changes the learning and teaching experiences in vocational education and training.

This is the starting point for innovative projects like EDU-VET, where we try to provide solutions for activating learners, especially apprentices form the field of the metal sector, and solutions for personalised approaches in initial vocational education and training.

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2. New media and E-Learning at VET schools – First ideas of digitisation and fostering of digital competences

Jana Stelzer

The megatrend of digitization in the organizational context is illustrated by the fact that this term has more than 50,500,000 (September 2020) entries on Google. Further reasons for these changes include digital transformational processes in various institutions, organisations and companies. However, digitisation also presents numerous challenges for the educational sector. In the field of education new challenges have arisen as a result of digitisation processes (cf. BEUTNER 2019; cf. KMK 2016). Keywords such as *digitisation* and *industry 4.0* are more present than ever before (cf. SLOANE / EMMLER / GÖSSLING / HAGEMEIER / HEGEMANN / JANSSEN 2018).

> "Digitization is the process of converting analog signals or information of any form into a digital format that can be understood by computer systems or electronic devices. The term is used when converting information, like text, images or voices and sounds, into binary code. Digitized information is easier to store, access and transmit, and digitization is used by a number of consumer electronic devices" (TECHOPEDIA 2020, n.p.).

In this context, it is necessary to improve the education system using innovative knowledge and new ways of teaching and learning in order to deal with the challenges of digitisation. Digitisation is becoming increasingly important for vocational schools (cf. BEUTNER 2019). In addition, digitisation requires new fields of action on the part of teachers and learners. Within these fields of action there are various influences. According to the German KULTUSMINISTERKONFERENZ (KMK) (the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany) each school in Germany is required to consider the following fields of action in order to improve the learning outcomes of their students:

- "Educational plans and teaching development, curricular developments,
- education, training and further education of educators and teachers,
- infrastructure and equipment,
- educational media, content,
- E-government, school administration programs, education and campus management systems,

- legal and functional framework conditions“(KMK 2016, p. 4).

Depending on the type of school, digitalisation influences these areas to varying degrees (cf. KMK 2016). As a result of these changes new learning strategies have to be developed which take the curriculum and the content of the lessons into consideration (cf. IBID.). Further, the fostering of digital competences also has to be taken into account for the VET sector (cf. DIGCOMPEDU 2018).

With regard to the first aspect, the KMK identifies two objectives:

1) All the federal states in Germany are required to support those competences which are necessary for active, self-determined participation in curricula and in the education and framework plans. Digital competencies have to be developed alongside professional competencies. Therefore, it is necessary to adapt all the learning areas to the process of digitisation. Integrating the digital world is essential (cf. KMK 2016).

2) Adapting the design of the lessons leads to more freedom for the learner´s individualisation. Learners also have the opportunity to take personal responsibility (cf. SLOANE ET AL. 2018). Furthermore, digital learning environments help students to become part of a team and to develop solutions and provide feedback. The students can take on more responsibility for designing their own learning process and learn to apply their theoretical knowledge to practical situations (cf. KMK 2016).

In conjunction with the development of new curricula and learning content, the challenges of fostering digital competences have to be faced (cf. IBID.). The focus in this context is on the learner´s digital skills which, due to the increasing importance of digital skills within the VET sector, need to be developed and improved (cf. IBID.).

In response to this situation, DIGCOMP 2.1 and DIGCOMPEDU have published a research study and provided a digital competence framework for vocational education, namely the “DigComEdu Framework”. It is defined as follows (cf. DIGCOMP 2.1 2017; cf. DIGCOMPEDU 2018):

> “The DigCompEdu framework aims to capture […] educator-specific digital competences. The framework is directed towards educators at all levels of education, from early childhood to higher and adult education, including general and vocational training, special needs education, and non-formal learning contexts. It aims to provide a general reference frame for developers of Digital Competence models, i.e. Member States, regional governments, national and regional agencies,

> educational organisations themselves, and public or private professional training providers" (DIGCOMPEDU 2018, p. 1).

However, it is not only new digital competences that are required: methodological, social and personal skills are also important for working with networked systems (cf. BIBB 2018). The following quotation emphasizes the importance of well-qualified learners, and shows its relevance for the professional world, and particularly the metal sector:

> "Due to the increasing complexity of networked systems and the shortening innovation cycles of new technologies, the demands on the problem-solving and self-learning skills of all employees are also increasing" (IBID., p. 6).

Therefore, vocational training and professional development is increasing in significance. Digital transformation processes require qualified skilled workers who are well prepared for the professional demands of the future, as well as a flexible and innovative education system. These demands include, for example, learning in the work process, manufacturer training, and the use of relevant trade journals as well as corresponding online learning opportunities (cf. BIBB 2018).

Although vocational training is becoming increasingly more important, only a minority of schools have so far focused on digitisation and the required fields of action. There is a need to adapt digital transformation processes, particularly in vocational schools for the metal industry (cf. BIBB 2018).

In summary, for teachers and VET schools the changes in the economy and in the digital world are leading to new requirements. In the future, VET schools will have to do more than provide Smartboards or a computer room to indicate that they are prepared for the challenges of the future. They will be required to provide digital courses as well as online lessons and to integrate e-learning modules into their daily teaching activities. Furthermore, a key aim of the curriculum must be to improve the learner's digital competences. The next chapter presents the EDU-VET project's conclusions on this topic.

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3. Importance of digitisation and new media approaches at VET schools in the metal industry

Stanley Willemsen

Figure 1: Wall print in classroom VET school Graafschap College
Source: Design Henk Hilferink (2016).

3.1 Introduction

This section *Importance of digitisation and new media approaches at VET schools in the metal industry* is all about the use of modern education tools. First we look at the present and future possibilities and then look at what is especially useful for VET schools and the metal industry.

We started with the assumption that digital teaching materials and new media across metal education in schools were poor and have mainly been developed by enthusiastic teachers with a knowledge of computer-technology provided through websites. Alongside this, some digital materials & resources may have been provided by the companies manufacturing the machines, although they are often costly and not available for the general education.

Until recently the situation relating to digitisation across the metal sector, has been fairly traditional. Many of the people using the machines may not have been familiar with working on computers or laptops. Whilst this is starting to change, the sector is still viewed as being predominantly practical, rather than digital. The metal industry is still associated with gloves, goggles, welding torches and safety shoes; and not with PCs, laptop and high-tech, clean machinery.

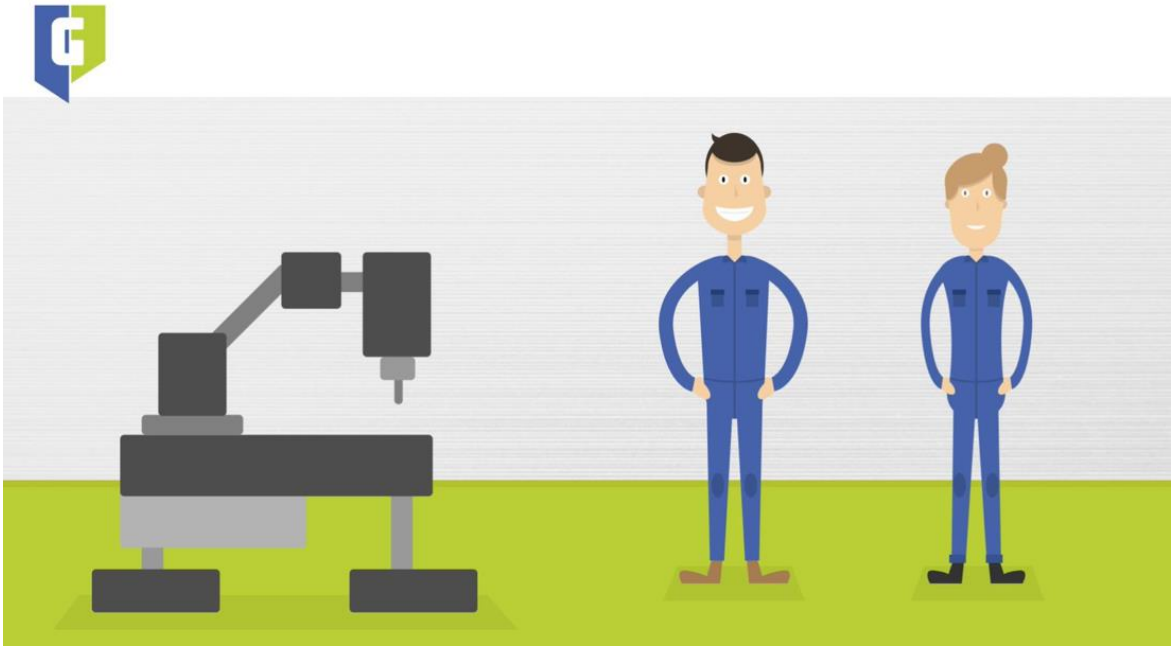

Figure 2: Source animation Graafschap College Metaalimpuls
Source: Graafschap College (2021).

Education across other sectors e.g.) Chemical, Automotive, Engineering, Web Development and ICT, have the distinct advantage that their work is largely reliant upon computers, and this has been adapted across the various curriculum. This gives an advantage in the step to digitization and the usage of new media.

This is a reason to put much effort in this main topic at the project EDU-VET. There is a lot to gain from these “first” and collaborative digitization steps.

It is important to choose the right extensions, formats and hardware. These techniques are rapidly evolving. Initially we relied on textbooks, and then these progressed to include colour images and diagrams. From the 90’ onwards, the arrival of the internet and access to affordable computers meant that information was widely available on websites, and we need to prepare our content in response to this, ensuring it is suitable for VR and AR equipment.

Can you still view your own VHs or Betamax videos from your childhood? These systems are rapidly growing old.

3.2 Gamification

Although gamification is for some educators the Holy Grail to reach in teaching & learning, it is not always relevant to all sectors. For example, it would be hard to learn very practical skills and you could not currently become qualified in milling and turning through playing a game. It would also be a very expensive way to learn! However, we still we can gain from taking some of the knowledge and advantages which come from gaming, and some elements can easily be taken and adapted from game design for use within the metal-working sectors. For instance, earning levels or badges at certain stages of progression within the game, which would be easy to implement and gives the students the feedback and feeling of progress and earning points as rewards.

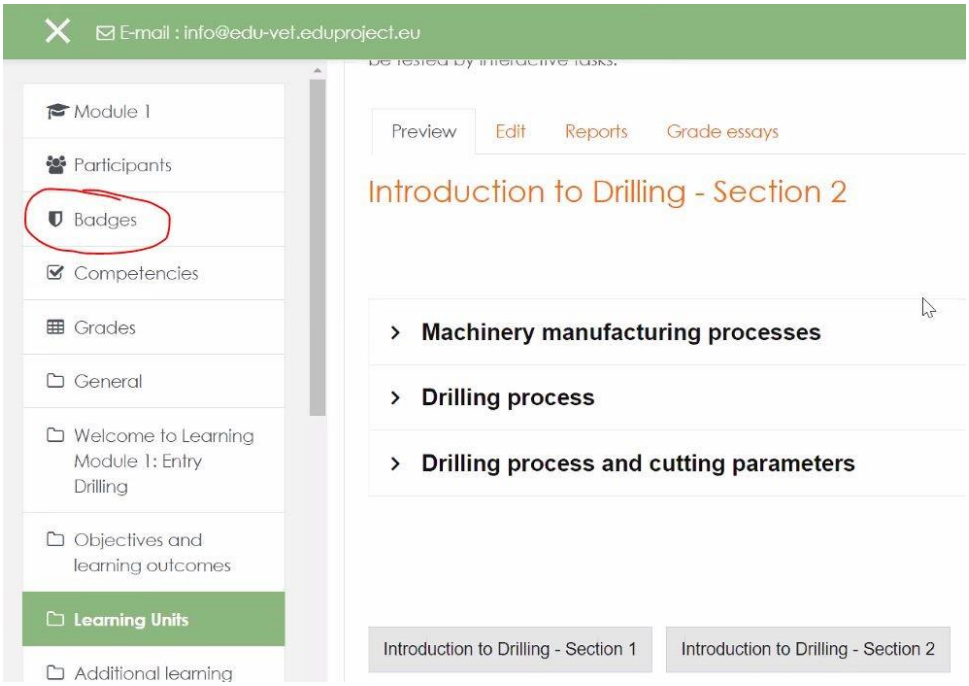

Figure 3: Screenshot of EDU-VET Learning platform
Source: http://edu-vet.eduproject.eu/

In a school or college setting, we can use the joy of learning through adapting gaming ideas and introducing a competitive element to the curriculum.

" How many program lines did you need to program this Milling pattern?"

3.3 New Media

We are constantly learning new ways of working through the use of new media, and most of this “new” media are not so new anymore; YouTube first launched in 2005!

If you want to learn something about a device few of us would search through a handbook or manual for the information. Most of us – and certainly the younger generations - would now turn to Google or YouTube. Of course, at YouTube we can learn a lot, but you need to consider a couple of things when looking for information. 1) Do I know the right words to search to find the video I want? 2) Is the video I have found accurate and is it worth watching?

There are lots of examples of teachers using YouTube to explain a range of subjects and some of these are exceptionally good and these videos will be watched by thousands of students. Math teacher Henk is used a lot by students. With Covid-19 a lot of lessons are recorded and available online for free. Knowing the way to the right video at the right time is one of the key roles of good teachers these days.

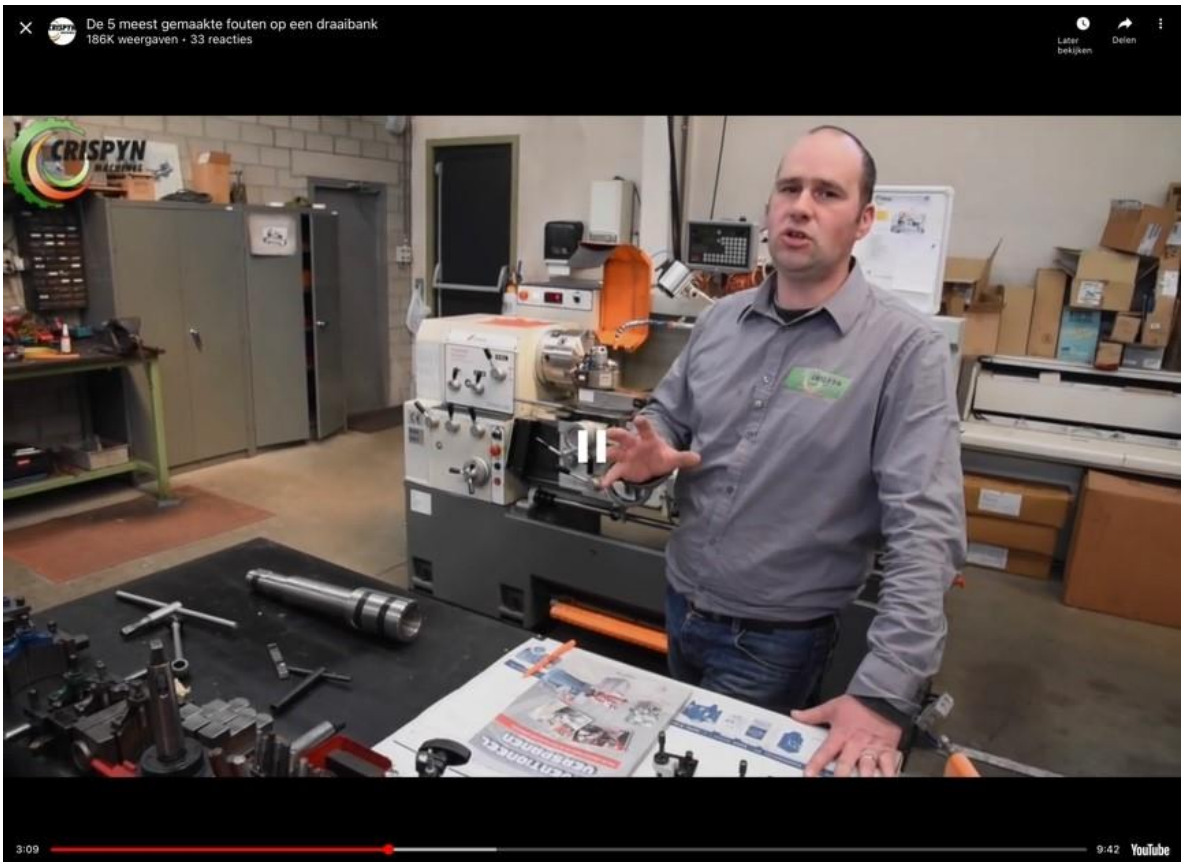

Figure 4: A lot of instruction videos on YouTube
Source: CRISPYN at Youtube.com (2021).

The process is the same for a whole range of new media, including Podcasts, Clubhouse meetings, A Forum but also websites which may focus on a specific topic.

Building new didactic material is not always about making newer content with better quality, but it is more about finding your way through the vast forest of good and rich content that is already available on the web.

3.4 Time Advantage

Digitization and automation in general have one driving force - and that is money. On a purely practical level, time is money. So, digitization of the education in VET schools will save a lot of money. Or, put a different way: if you don't invest in improving learning materials, you will need to buy a lot of machines to learn on! So, there is a huge economic advantage to be had from the digitisation of training materials and resources.

Real world tools and machinery in the Metal industry are very expensive and many schools would only be able to afford to replace their equipment every 20-30 years. So, if you can teach some of the basics, such as health & safety, not at a physical real machine but through software or simulated modern machines, that's great!

Using digital resources, you can teach any number of students simultaneously, but if you only have 4 machines in a classroom, then only 4 people can learn at any one time. So, during the introductory sessions, when most of the lesson is needed for explanation, and the machines stays silent for hours and hours, you don't need to be based within the workshops and these costly hours can be used at another time.

3.5 VR & AR

Now we think the digital school is about ELO and YouTube lessons and maybe an online questionnaire. The real deal will be VR and AR. This is the closest thing to real machine handling.

This is really coming to town.

Of course, these new techniques will first be used by the big companies like Hilton and Boeing.

3.6 H5P

In our online education modules we use H5P techniques to enrich the content. We can also develop new content types. Use your smartphone and read the website by pointing to this QR code in the image. Now we also demonstrated the nice way to enrich text with QR-codes.

3.7 Adaption

A very welcome feature of software education is the ability to adapt to the knowledge of the student. By asking a range of questions the software determines the entry level of the participant. The level of questions is then adapted to suit the individual user. This means that there is also a part that will be skipped. Squla in The Netherlands is a very good example of software that uses Adaption.

3.8 Internationalisation

Web sessions or online events will bring technology or knowledge from abroad on your screen.

3.9 Knowledge Management

To capture knowledge from experienced staff on instruction videos or just written material on a server can preserve knowledge that otherwise may leave a company, once the person moves on. Traditionally, the metal industry has a lot of older, experienced employees and this is increasing as it becomes more difficult to interest young people into this sector. The perception for many young people is that it is difficult, dirty work.

3.10 Search Engine

If you have a lot of learning content in one environment such as Its Learning, Moodle or Blackboard, you have the benefit of searching through it. If you have a wide range of topics, Moodle lets you browse through the content in various ways.

Figure 5: Screenshot of EDU-VET Learning platform
Source: http://edu-vet.eduproject.eu/

Companies are willing to help. They have the tools and are at the top of the technology.

3.11 Ch€ap

Money is best the motive to digitizing the curriculum.

3.12 Teamwork

In the digital world it is easy to collaborate and work together towards one goal. Language is maybe a barrier, but the advantage of working together is speeding up and growing quickly.

Example Wikipedia.

ELO

3.13 CHAT or FORUM with professionals

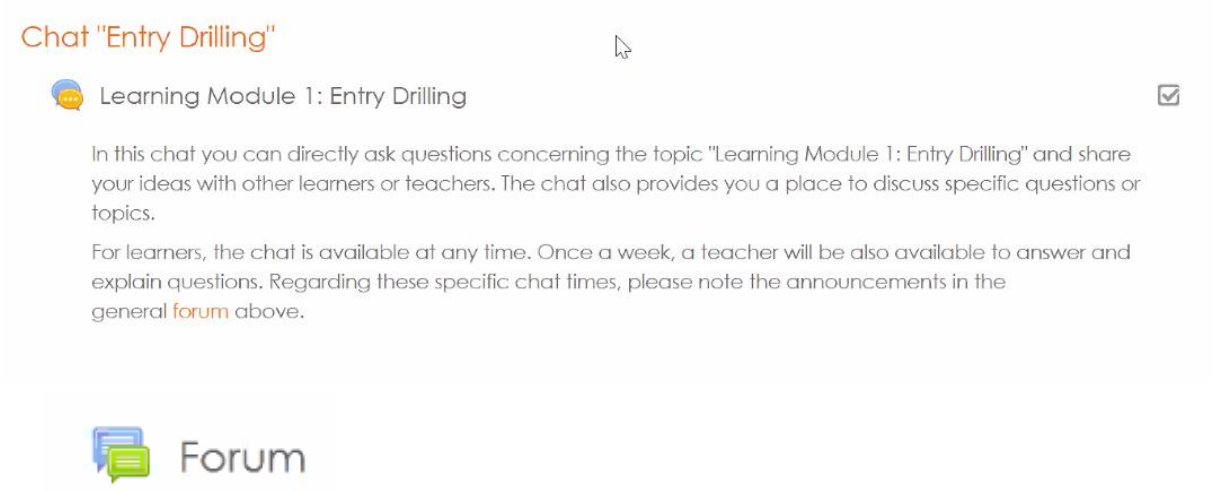

Figure 6: Screenshot of EDU-VET Learning platform
Source: http://edu-vet.eduproject.eu/

3.14 Source OCR XML

In the digital world it is easy to reuse Content. With XML and HTML old looking text is fresh and attractive with the press of a single button. Especially in technical areas, where there may be a lot material which is still relevant, we can reuse this material and update them accordingly.

With OCR techniques we can use old text and capture it in online material.

3.15 Fewer real machines

If we digitize a lot we can use the real machine effectively.

3.16 IP camera Stream

You can use IP cameras to observe the real machines. Companies are already doing this to see if the 24/7 runs are going ok. This we can use to show students the real deal.

3.17 Place independent

You don't have to travel to a place where the real machine is.

3.18 21 century skills

A positive imapct will be that the students will be prepared for 21st Century skills. The work will be more laptop-based and time spent at the machines will lessen.

3.19 Simulation & Digital Twinning

If you want to speed up education in a cost-effective way then you can start with Simulation software or Digital Twinning.

In the metal industry and especially metal education you can benefit from software that is provided by Turning and Milling manufacturers.

SYMplus software from the company Keller is such a software.

3.20 Combining all items

If you combine all the possibilities than you have more than the addition of all functions.

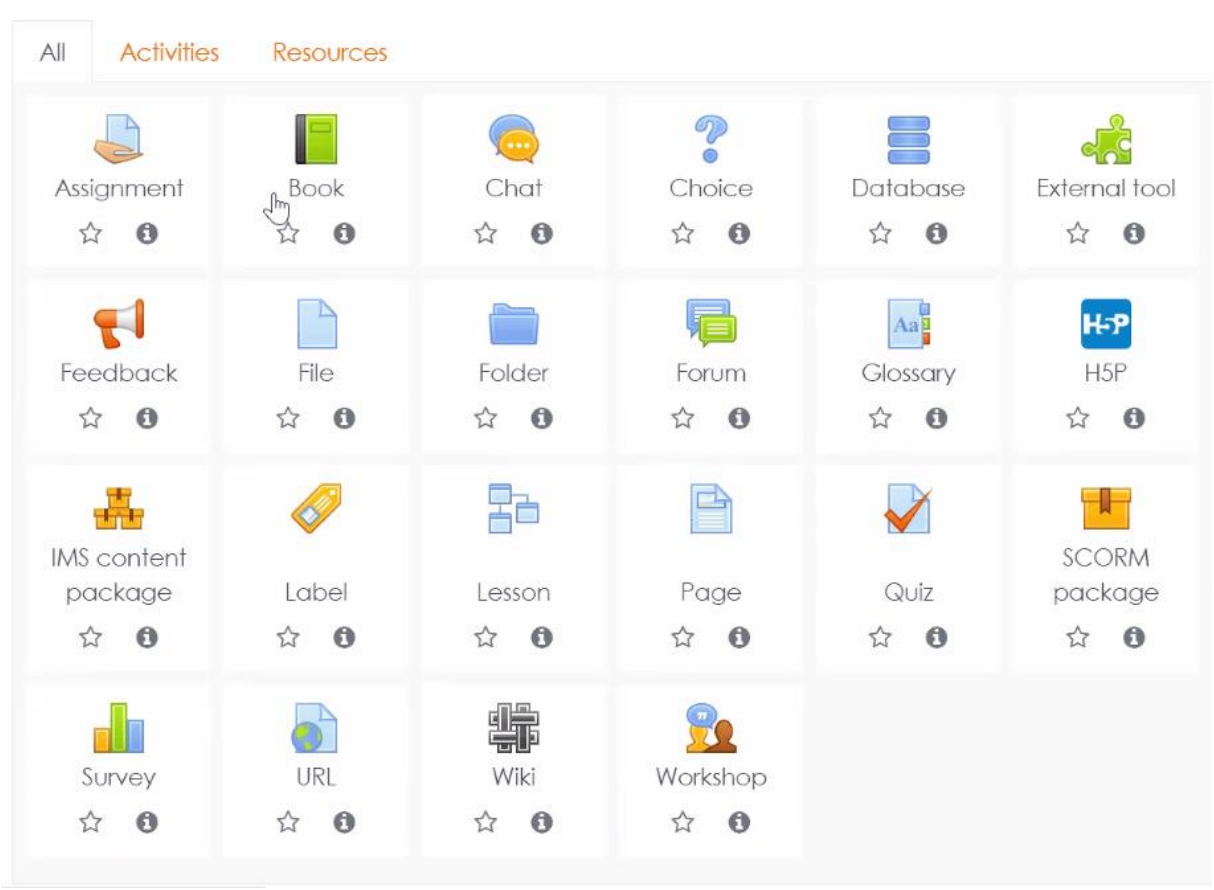

Figure 7: Screenshot of EDU-VET Learning platform
Source: http://edu-vet.eduproject.eu/

3.21 Conclusion

There is no reason not to invest in digitization of the Metal-industry and education. It is not the question of 'if'; what we should be asking is: How is best outcome to be gained with the least investment of time and money?

VR and AR techniques are interesting where there is a lot of skill training to do. Welding is a good example of the use of this technique.

The conclusion is simulating software that is free of charge and ELO systems that are widely spread and also cost free.

So we only need time of the people who have the know-how and can teach it. If these are not available we should bring these two kinds together.

This EDU-VET project is an example of this goal and a good start in the Metal-industry.

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Part B – The EDU-VET project

4. EDU-VET – Core ideas, aims and structure

Jana Stelzer

The Erasmus+ Project EDU-VET (the acronym stands for “E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry”) addresses the challenges of the rapidly changing economic environment and its transfer into pedagogical settings.

The project, which has a duration of 31 months (the funding period is 01.09.2019 to 31.03.2022), is coordinated by Professor Marc Beutner at the University of Paderborn in Germany. The other five European project partners are: the Ingenious Knowledge GmbH and the Bocholt-West Vocational School in Germany; Lancaster and Morecambe College in the United Kingdom; the Centro Integrado de Formación Profesional Somes in Spain and the Stichting BE Oost-Gelderland in the Netherlands. The project is financed by the European Union.

4.1 Main objectives and core aspects of EDU-VET

The main objective of the EDU-VET project is to create a new way of teaching and state of the art learning environments for VET. The project focuses on the development of e-learning courses. For this reason, the project partners will design a curriculum as an online teaching approach for technical education at vocational schools. This supports both teachers and learners through providing appropriate innovative learning resources, modern learning activities and effective methods of gaining knowledge.

In addition to the main objectives of EDU-VET, the following core aspects will be included after the implementation of the new learning system. Firstly, creating the EDU-VET Curriculum, as well as online courses, is crucial. In addition, there is a focus on the development of new teaching and learning environments for VET in order to increase the acceptance of digital technologies and foster the learner´s digital competences within learning in the metal industry. The project aims to implement a learning platform that reduces and removes barriers to education. Furthermore, EDU-VET creates an online showcase for companies in the metal industry sector to allow authentic teaching which is also user-friendly. Manuals as well as guidelines are provided to the teachers.

The following section deals with the individual core elements in detail (cf. EDU-VET APPLICATION 2019).

4.2 Developments of EDU-VET

The project will develop six Intellectual Outputs (IOs) in total. These project outputs involve the following:

1) Intellectual Output 1: Summary Pedagogical Research Report on the use of e-learning in the metal industry

The Summary Pedagogical Research Report is based on the research processes of the individual project partners. The research has been carried out in two ways. The first part involves desk-based research, and the second part is field-based research. The field-based research comprises both quantitative and qualitative approaches. For the quantitative study the project partners participate in an online survey. The target groups are VET teachers, VET educators, VET providers, VET trainers, employer representatives, employee representatives, unions and representatives from chambers of commerce. The qualitative part consists of four interviews with teachers and trainers from the metal industry.

In summary, the proposed research to be conducted by each project partner will:

- identify modules to be developed in the EDU-VET Curriculum;
- highlight topics to be addressed in the courses by the VET professionals;
- inform the design of the curriculum modules to ensure that high-quality standards are met in the content;
- provide feedback on the use of learning units and online courses in the field of VET for the metal industry.

The responses to all of the aspects listed above will affect the curriculum framework and learning outcomes matrix that will be used to guide all the development actions. The curriculum framework will show the content and learning outcome guidance on a module-by-module basis in order to support the development work of partners ensuring that all the areas of required learning identified are appropriately considered and addressed. Using this learning outcomes approach as a key element of the pedagogical strategy allows individual learning content to take account of the different cultural patterns in the partner countries without compromising the value of the learning resource.

2) Intellectual Output 2: Technical Education Curriculum for the metal industry

A modular VET curriculum for the metal industry will be developed as a basis for the online courses and learning modules on the learning platform. The aim is to support the acquisition of key high-value competences and to establish modern and innovative learning in the field. The development of the new curriculum will require an “ab initio” approach, since there are no systematic educational resources available for the target groups in the partner countries.

The EDU-VET modules for VET learners are included in the EDU-VET Curriculum. These modules are based on the research conducted in each partner country. For the learners EDU-VET focusses on three modules:

- Module 1: Drilling/ Reaming/ Counterboring/Thread cutting
- Module 2: Turning
- Module 3: Milling

Their didactical und curricular conception, as well as the Learning Outcome Matrices, are described in detail in the following chapter.

3) Intellectual Output 3: Online courses for technical education in the metal industry

With regard to the EDU-VET Curriculum, the project team is working on the development of the online courses and modules. This includes content design, task design, interactive tasks, quizzes, questionnaires, videos, audios and illustrations. It also includes the design of different ways of navigating the modules.

The creation of new types of digital learning and teaching materials will be implemented via the H5P platform. The programme and its functionalities were described in Chapter 7. The following section provides an insight into selected task formats.

4) Intellectual Output 4: Handbook and guidelines for teachers

IO4 focuses on the creation of the EDU-VET handbook and the teacher guidelines. It will be available as a book in 2022 and will be published in English, German, Dutch and Spanish. The handbook provides information about innovative learning processes in the metal industry and is addressed to VET teachers as well as VET educators. It will include the following content:

- Overview of the current situation
- Overview of the EDU-VET approach
- Opportunities and challenges of online courses and blended learning approaches for VET
- Definitions of digitisation and Industry 4.0 in relation to the metal industry

- EDU-VET Curriculum and the use of new media in metal VET
- Research results of the EDU-VET research
- Opportunities and challenges
- Best practice pedagogical materials and showcasing
- Future developments in the field
- Insights into courses, modules and accreditation issues.

5) Intellectual Output 5: Showcasing of best practice in e-learning at VET Schools

IO5 aims to create an online showroom for companies from the metal industry in order to foster authentic teaching. The project partners will develop an innovative online showcase for enterprises in the metal industry, their processes and products.

The objectives of this online showcasing are:

- to present role models for metal enterprises and their owners to improve learning and teaching processes and to provide realistic teaching information;
- to provide instant access to a library of information resources verified by partners during the research period that might be useful for teachers;
- to provide a range of online environments and forums where teachers and VET professionals can collaborate and exchange ideas as well as practices with their peers in partner countries and collaborate with each other.

The showcases are prepared by the partners and bring together the important information under consideration of the guidelines. These guidelines are based on criteria which are used in the showcase presentation of the information. The partners collect graphics, videos, text descriptions about the enterprises, their processes, aims and target groups as well as contact data, perspectives and pedagogical hints which are helpful for schools.

6) Intellectual Output 6: EDU-VET - Policy Paper with recommendations to policy makers

As part of the last IO6 the partners will write a Policy Paper with recommendations to policy makers. The policy recommendations are developed based on all the results and developments of the IOs. They include five core elements.

Firstly, the Policy Paper addresses the importance of the use of new media approaches and e-learning activities for the metal industry. As well as the necessity to focus on emerging opportunities with innovative learning approaches, a well-designed common curriculum is essential to ensure a long-term knowledge development. Furthermore, the importance of future accreditation, certification and adjustment to EC-VET standards will also be discussed. Finally,

the handbook highlights the importance of bringing the worlds of VET and the daily work of businesses closer together by designing relevant curriculum resources.

In summary, the Policy Paper will consider why a change of policy approach might be relevant. It will recommend a course of action based on the lessons learned within the EDU-VET project (cf. EDU-VET APPLICATION 2019).

4.3 The EDU-VET results

If all developments of the IOs are combined, the following EDU-VET results can be identified:

(1) the EDU-VET Curriculum
(2) the EDU-VET Learning and Teaching Resources
(3) the EDU-VET Online courses (Blended-Learning approach) for the metal sector
(4) the EDU-VET Online-Showcase with insights into metal companies, best practice information and videos
(5) the EDU-VET Book on innovative teaching/ learning in the metal sector
(6) the EDU-VET Research report
(7) the EDU-VET Dissemination materials (posters, leaflets, brochure, cards, pens, flyers)
(8) the EDU-VET Website with Blog
(9) the EDU-VET Guideline for VET educators and teachers
(10) the EDU-VET Videos (integrated on the website and the online showroom)
(11) the EDU-VET OER strategy
(12) the EDU-VET Digitisation concept for VET
(13) the EDU-VET Publications, newsletter and press articles
(14) the EDU-VET Research results
(15) the EDU-VET Evaluation report (cf. EDU-VET APPLICATION 2019).

The following chapters focus on these results in detail, so that only a brief overview is given here.

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5. The EDU-VET blended learning approach

Gert André

5.1 Definition of blended learning

Arguably one of the most common definitions of the term Blended Learning is that of Graham who expresses it as learning systems that "combine face-to-face instruction with computer mediated instruction" (GRAHAM, 2006, p.41). Variations of this definition abound also in papers published throughout the years (CHARBONNEAU-GOWDY, 2018; BANDITVILAI, 2016; SOEIRO, DE FIGUEIREDO and FERREIRA, 2012; ONGUKO, 2014; TSHABALALA, NDEYA-NDEREYA and VAN DER MERWE, 2014; GYNTHER, 2016; NAKAYAMA, MUTSUURA and YAMAMOTO, 2016; KINTU and ZHU, 2016; NORTVIG, PETERSEN and HATTESEN BALLE, 2018; UZIAK ET AL., 2018; JAKAB, ŠEVČÍK and GREŽO, 2017). Very few authors, however, explore any of the other elements that may form part of the blend in blended learning as defined in the earlier definition by Marcy DRISCOLL, who presents a more refined definition that includes:

- To combine or mix modes of Web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to accomplish an educational goal.
- To combine various pedagogical approaches (e.g., constructivism, behaviourism, cognitivism) to produce an optimal learning outcome with or without instructional technology.
- To combine any form of instructional technology (e.g., videotape, CD-ROM, Web-based training, film) with face-to-face instructor-led training.
- To mix or combine instructional technology with actual job tasks in order to create a harmonious effect of learning and working (DRISCOLL, 2002, p.54).

Background

The origin of the term blended learning is generally traced back to a 1999 press release by EPIC learning in Atlanta (FRIESEN, 2012), who points out that, from the outset the term has been plagued by ambiguity, and concludes: "Blended learning, in other words, is almost any combination of technologies, pedagogies and even job tasks. It includes some of the oldest mechanical media (e.g., film) and theories of learning (e.g., behaviourism), as well as the newest" (FRIESEN, 2012, p.2). In 2006 GRAHAM deplores the ambiguity of the term in that: "these positions suffer from the problem that they define [blended learning] so broadly that they encompass virtually all learning systems. One would be hard pressed to find

any learning system [or combination of methods] that did not involve multiple instructional methods and multiple delivery media" (GRAHAM, 2006, p. 4).

After an extensive analysis of the various definitions of the term Friesen proposes that "Blended learning' designates the range of possibilities presented by combining Internet and digital media with established classroom forms that require the physical co-presence of teacher and students" (FRIESEN, 2012, p.1)

Elements of the blend

For Known knowledge cause and effect are repeatable, perceivable and predictable and legitimate best practice and standard operating procedures have been established. In this case direct (behaviourist) instruction is the most appropriate. Using problem-based learning in this field would lead to frustration and a waste of time (CLARK, KIRSCHNER and SWELLER, 2012) the blended learning model would therefore concentrate on Instruction. In a contact environment this would amount to lectures and demonstrations and in a distance environment books (physical or digital) or (instructional) videos.

For Complex knowledge cause and effect are only retrospectively coherent, and pattern recognition is required. Here a constructivist approach is appropriate. Learners learn how to make sense of complexity. It is important to recognise that constructivist learning is more about learning to learn than about learning to acquire skills –as was pointed out in an earlier issue of this journal: "knowledge construction is highly exhibited and significant factors in this include learner interactions and management of workload" (KINTU and ZHU, 2016, p. 192). This is the quadrant of abductive reasoning. Construction tasks, problem-based learning and open-ended learning environments would be appropriate here. In a low-technology environment physical puzzles would be useful and in a high-technology environment spreadsheets and other information-processing tools would be recommended.

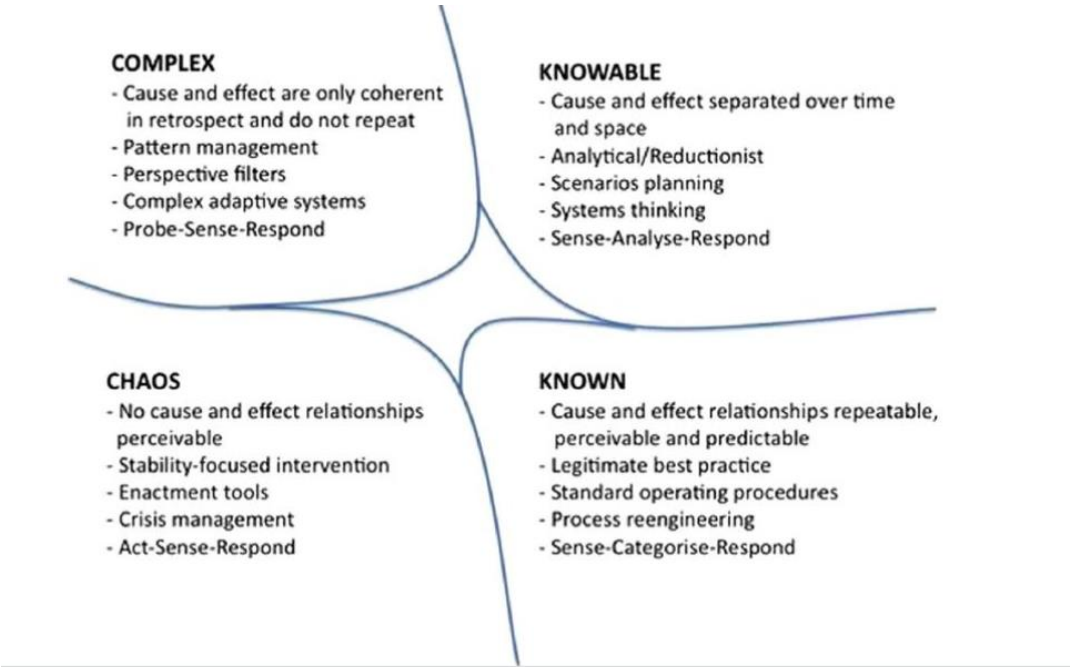

Figure 8: The Cynefin framework
Source: KURTZ AND SNOWDEN (2003, p.464).

In the Knowable domain that calls for analytical and reductionist thinking with cause and effect separated over time an Integrated use of behaviourist and constructivist learning would be appropriate. This is the domain of puzzles rather than problems. Puzzles have solutions known to the instructor but not to the learners, while problems may have endless solutions. The aim in this quadrant is to teach systems thinking. In a contact environment this is where discussions and debates are likely and in a distance environment it is the domain of chat groups and bland discussion forums.

The Chaos domain is the domain of experience. There is no perceived cause and effect relationship and interventions are aimed at regaining stability. Traditionally this is known as "being thrown into the deep end" or Immersed. In this quadrant there is no evidence of planned intervention of either a behavioural or constructivist nature. Yet this is where SHIPLEY (2017) argues that most learning takes place. This is the domain of the field-trip, the experiential learning and the apprenticeship. In this context teaching is notably absent and learning is incidental and serendipitous. The technology involved here is the logbook, and the blog, and the methodological focus should be on assessment rather than instruction.

Context (Kurtz & Snowden)	Theory (Cronje)	Methods	Technologies
Known	Injection	Tutorial Drill	Lecture Book Video
Complex	Construction	Construction Exploration	Open-ended learning environments Construction kits and tools Spreadsheets
Knowable	Integration	Puzzle Discussion Debate	Games Discussion tools
Chaos	Immersion	Experience Field trip Apprenticeship	Blogs Logbooks Assessment tools

Figure 9: Blended Learning decision matrix
Source: CRONJE (2006).

Definition

We can define Blended Learning as a "combination of two or more of all possible learning types".
But we also can define it as "The appropriate use of a mix of theories, methods and technologies to optimise learning in a given context". In my opinion the second definition is the most appropriate one, because this definition takes into account the context of learning.

5.2 Chances of blended learning in VET education

Online and offline learning both have their pros and cons. That's exactly why you can create a powerful lesson with a combination of them: Clear, alternating and appealing.

Research into the effects of blended learning compared to face-to-face education, without the use of digital tools, shows that the effectiveness of blended learning are on the average positive (Spanjers, Könings, Leppink, & van Merriënboer, 2014). This is independent of the field.

Digital tools as a supplement to offline teaching techniques can therefore be a positive contribution to learning outcomes.

Opportunities

- Create a clear vision for blended learning and find support for this vision. Use a top-down approach, from the management layer, to outline frameworks. For the actual elaboration, it is best to use a bottom-up approach, in other words from the teaching practice.

- Provide sufficient time and space to teachers for educational design. Ensure that the preconditions for the implementation of blended learning are present.
- Offer incentives, for example in the form of small-scale subsidies and professionalization processes.
- Provide teachers with the right professional, didactic and technological support.
- Focus on the valorisation of the quality of top teachers: make use of role models and knowledge sharing.
- When designing blended learning, take into account a valid educational starting point and a good design. Choices about the right balance between online and physical must be made on the basis of the target group and the learning content.

5.3 Challenges of blended learning in VET education Challenges

- There is no time and no space. Designing blended learning takes a lot of time, time that is often not there. Take this seriously. It is really unrealistic to expect that all lecturers will be able to design their teaching in a blended way.
- The vision is unclear, flawed, not worn or only present at the top. There is no good translation into practice within all layers of the organization. Having a vision does not mean that it is reflected in practice. A mismatch quickly arises between what the management layer wants and what actually happens in practice.
- Teaching and technical skills of teachers are inadequate. This forms a barrier to taking risks and experimenting
- There is no suitable support, for example in the form of educationalists, ICTO support staff or I-coaches.
- It is unclear how blended learning should be designed. There is a poor provision of information or no underlying educational foundation.

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6. Insights into the results of the EDU-VET Summary Research Report

Marc Beutner / Jana Stelzer

The Intellectual Output 1 of the EDU-VET project focuses on the development of a Summary Research Report. The research results of this Summary Research Report are the basis for the conception of the EDU-VET Curriculum and the creation of the EDU-VET Learning Modules.

Therefore, the proposed research to be conducted in each partner country will:

(1) identify modules to be developed in the EDU-VET curriculum;

(2) highlight topics to be addressed in the courses by the VET professionals;

(3) inform the design of the curriculum modules to ensure that high-quality standards are achieved in content production;

(4) get a common feedback on the use of learning units and online courses in the field of VET for metal industry (cf. EDU-VET SUMMARY RESEARCH REPORT 2020).

The Summary Research Report contains the research results concerning the desk-based research and field-based research concerning the Intellectual Output 1. Moreover, the report presents findings acquired in a research process carried out between November 2019 to August 2020 by six project partners in four European countries (Germany, Spain, United Kingdom and the Netherlands) in the framework of the EDU-VET project (E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry), financed by the Erasmus+ Programme of the European Commission.

Based on the main objectives above the research was conducted in two ways. On the one hand, a desk-based research acquired through literature review. On the other hand, a field-based research acquired through a survey questionnaire and interviews with teachers and trainers in the metal sector.

The results based on the literature research and existing resources and experiences and were conducted by all partners. Part 1 presents an introduction to the report. Part 2 focuses on a text focusing on the existing resources and didactic materials at the own institution, which can be a basis for the work in the other IOs. Here learning and teaching materials will be addressed. Part 3 shows a text focusing on existing experiences with new media, e-Learning and blended

learning. Part 4 highlights a text on key skill areas of a VET curriculum in the metal sector. Part 5 summarizes the findings.

In the second Part B findings from the field-based research are shown. The research was achieved through both qualitative and quantitative parts.

The first part of the field-based research, the interview study from each partner, consists of 4 interviews with teachers and trainers in the metal sector. The second part of the field-based research from each partner consists of a quantitative survey. Each partner should provide answers from at least 100 participants to ensure that each answer stands at least for just 1 percent and no less.

6.1 Results of the literature review applied in partner countries

The literature review addresses the key skill areas of a VET curriculum in the metal sector. This topic contains following areas: (1) Key skill areas that need to be addressed in the EDU-VET proposed curriculum in the metal sector; (2) Key skill levels that are appropriate to local target groups; (3) Most appropriate media formats for learning content for target groups; (4) Type of assessment framework that would be most appropriate to facilitate the measurement of attainments; (5) Most appropriate technology platforms to be developed as e-learning environments.

(1) Key skill areas that need to be addressed in the EDU-VET proposed curriculum in the metal sector

Most of the key skill areas identified within the national reports are based on policies and strategies of the national ministries of education. As a result, uniform guidelines at a European level do not exist. For this reason, it is necessary to identify key skill areas for developing a VET curriculum in the metal sector within the project EDU-VET.

Digital competences, methodological and learning competences are required for mastering networked systems. These competences are necessary for developing, building and operating these systems. Moreover, there are other key skill areas of a VET curriculum in the metal sector. These also include technical competences (Professional competences), action competences, personal competences and social competences. The goal for trainees in the metal sector is "the acquisition and development of occupational and interdisciplinary competence to act", which enables pupils to act in professional, social and private situations (MINISTERIUM FÜR SCHULE UND BILDUNG DES LANDES NORDRHEIN-WESTFALEN 2019, p. 7). "By promoting the skills for lifelong learning as well as flexibility, reflection and mobility, the young people are to be

prepared for a successful professional life in a changing economic and working world at national and international level" (IBID.). *(Germany)*

"It is vital that employers have the workforce they need to enable them to grow and prosper in a global economy. They need the provision to be both relevant and of high quality" (WOLF 2011, n. p). So, the need for a learner/student to embrace Digital skills is growing more important. With the technology that is becoming more available and the need to be able to operate basic systems such as Microsoft software, learners are encouraged to evidence their skills in different ways. Within the curriculum and apprenticeship standards, it is a minimum requirement that Level 1 is achieved and Level 2 attempted (Level 2 qualifications) and a minimum of Level 2 achieved for a Level 3 qualification. *(United Kingdom)*

Based on the Spanish National System for Qualifications and Vocational Education and Training (SNCFP) the following objectives have to be fundamentally intended for the EDU-VET curriculum:

- To adapt the professional training to the qualification demands of productive organizations
- To facilitate the adaptation of supply and demand on the labour market
- To extend lifelong learning beyond the traditional educational period
- To promote the freedom of movement for workers. *(Spain)*

Particularly, professional and subject-related skills need to be intensified in the VET metal sector. Against this background, firstly it is necessary to teach the basic knowledge, for example: Basic metalworking (Drilling, tapping, filing, drawing, drawing reading and knowledge of materials), Basic construction (Bending, lace, welding, welding symbols, types of welding, welding stresses and the way of welding), Basic sheet metal (sides), Basic machining (conventional turning and milling and setting), Basic electrical engineering (Reading simple diagrams, making wiring, lamps, recorders, sensors, name parts), Basic mounting techniques (bolt screw joints, bearings, gears, chain wheels), Knowledge of materials and material properties, Occupational health and safety. *(The Netherlands)*

(2) Key skill levels that are appropriate to local target groups

Although the key skill levels of the target groups in partner countries vary quite a lot, a common trend on the level that should be targeted was identified and refers to Level 1 (Introductory level), Level 2 (Intermediate level) and Level 3 (Advanced level):

In *Germany*, training in the metal industry takes place in a dual system, so that the quality of training in terms of technical skills is very well developed at all three competence levels. On the other hand, there is an increased need for fostering digital competences in schools and companies. These skills are only taught to a very limited extent.

Concerning the *United Kingdom*, it is necessary to improve the education system with innovative knowledge and ways of learning and teaching to face the pitfalls of digitisation. For vocational schools digitisation becomes a challenge. The learners are a new medium because they use technical devices such as smartphones and tablets in their daily lives. The need for an online curriculum has increased due to the COVID19 situation as more companies are choosing to operate remotely.

In *Spai*n, most VET schools and companies are in line with the most demanded professional profiles within the Spanish labour market through the intermediate and upper level diplomas hosted in their academic offering (technician in Machining and higher technician in Mechanical Production Scheduling), with the exception of the approach more focused on mechanical design. Its main drawback has to do with curriculum since it's necessary to update them. Thus, the updating of the VET curricula is required so as to give an appropriate and sufficient response to the changing Spanish labour market of the metal sector. It is not only a matter of enhancing the current contents but of including new ones, and fostering those which are worthy.

In the *Netherlands*, the digitisation process at schools and companies is at an appropriate level and is constantly evolving. In fact, the range of existing e-learning materials is very large, so students are quickly overwhelmed by it. Especially students at the lower levels have huge difficulties when learning with these materials. Therefore, they need more support than students at higher levels. Thus, it is necessary to develop structured online learning material.

(3) Most appropriate media formats for learning content for target groups

All national researches unanimously recommend, as being appropriate for the project target groups, a combination of face-to-face and online learning methods (blended-learning approach), with a focus and higher emphasis on the latter. The online environments provide easy access and distribution of the learning resources. The media formats most needed and expected to produce successfully results are: audio-video files and video clips, online platforms, slide-shows (PPTs), digital tools, webinars, MOOCs, interactive tasks (H5P), online showroom with best-practices. The Moodle platform seems to widely accommodate all learning requirements of the target groups.

(4) Type of assessment framework that would be most appropriate to facilitate the measurement of attainments

The assessment should be built around several crucial elements: overall aim, learning outcomes, delivery methods and assessment methods. It should be also accompanied by clear and timely feedback. The research at national level revealed a common vision upon the assessment framework of the EDU-VET curriculum and E-Learning modules, achievable through a complex combination of assessment:

Competence level:

- Level 1: Introductory level (refers to 12-14 years)
- Level 2: Intermediate level (refers to 14-16 years)
- Level 3: Advanced level (refers to 16-18 years)

Methods:

Blended-Learning approach:

- Classroom scenario
- Online scenario

Tools:

- Classroom scenario: tests, case studies, discussions, creating posters and flipcharts, group work, exercises/worksheets, assessment using technology-based simulators in workshops, workbook, best-practices, self-directed learning, life demonstration
- Online Scenario: H5P tasks, surveys, quizzes, questionnaires, peer evaluation, group work via break-out sessions, online discussion forum, EDU-VET Online Observatory, online video, slide-show (PPTs), creation of explanation videos, online case studies.

(5) Most appropriate technology platforms to be developed as e-learning environments

The national research reports show that different learning platforms are already being implemented in schools and integrated into teaching processes.

In *Germany* the learning platform Moodle is preferred. Moodle allows the integration of the H5P application. Moreover, there are existing learning Apps like the MATH App which focus on learning basic mathematical knowledge.

The VET schools in the *United Kingdom* use the applications of Microsoft Office 365, specifically TEAMS and platforms such as Kahoot are used to create fun online quizzes. The teachers also use Moodle but this is being phased out as MS TEAMS is more adaptable to online learning.

In *Spain* VET studies taught through PLATEGA platform were classified as blended learning and not online. This platform is based on the Moodle tool.

In the *Netherlands,* Microsoft Office H5P office programmes are also used. Additionally, they also use the learning platform It´s Learning.

Summarising, based on the reports and the previous experiences of the project partners and our technical project partner IK, the Moodle platform seems to be most suitable for delivering the EDU-VET curriculum in a blended-learning approach (cf. EDU-VET SUMMARY RESEARCH REPORT 2020).

6.2 Results of field-based research applied in partner countries

This chapter gives an insight into the results of the field-based research. Firstly, this section displays the (1) Key results of the interviews; afterwards there will be the presentation of the (2) Key results of the questionnaires.

(1) Key results of the interviews (qualitative part)

The results of the qualitative study show that most of the interviewed teachers and trainers have a huge pool of experience in the metal sector. Moreover, the majority have a basic or even advanced knowledge of e-learning and digital media. So that very helpful und suitable insights for EDU-VET can be drawn.

Almost all respondents see the topics Milling, Drilling and Turing as basic knowledge in metal professions. For this reason, the modules which have to be develop within the EDU-VET Curriculum will be focused on those topics.

Unfortunately, many teachers do not have didactic materials or learning resources that can be used for EDU-VET. However, some teachers offer their support within creating EDU-VET tasks by sharing their knowledge and experience with the project team.

Concerning the required pedagogic support to be facilitated into online learning and proposed blended learning environments, most of the teachers and trainers want to expand media literacy. Besides, they would like to prepare courses for the creation of online learning materials. Particularly, the trainers intend a regular exchange with learners, VET schools and companies.

Against this background, the respondents also use the following new media formats in class: internal e-learning platforms e.g. Moodle, H5P, active boards, video, audio, document camera, smartboards etc.

According to the chances or advantages of e-learning, the interviewed persons focus on following aspects:

- Independence in using (place and time)
- More flexibility
- Students can access the course anytime and anywhere
- Wide range of additional tasks
- Attractive presentation of materials
- Decoupling of communication processes (for teacher, pupils, parents and trainers etc.)
- Different ways to communicate: Chat, Videos, etc.

In contrast to the advantages, there are also disadvantages and challenges:

- Lack of IT skills
- Learners don’t have access to equipment
- Students need to get practice with real machines, which goes far beyond any simulator available
- Language difficulties
- Students are distracted on-line and can no longer concentrate on their work
- Technology-led sessions can demotivate
- No action-oriented lessons possible
- Limited integration of practical experiences
- Very demanding for students regarding:
    - mental abstraction
    - organization
    - persistence
    - determination

These results are also implicitly reflected in the results of the questionnaire study (cf. EDU-VET SUMMARY RESEARCH REPORT 2020). This is the focus of the following section.

(2) Key results of the questionnaires (quantitative part)

This part presents the key results from questionnaires applied in partner countries to a total of 531 persons. The questionnaire study was conducted online or paper based.

The profile of the target groups encompasses: VET teachers, VET educators, VET providers, VET trainers, employer representatives, employee representatives, unions and chamber representatives. Their age ranges from 20 to over 60 years old. Both men and women have participated in our survey.

The applied questionnaire contained 9 multiple-choice/ matrix items and 3 open-ended items. For the multiple-choice/ matrix items the options to answer were provided on a 4-level Likert scale and 6-level Likert scale (i.e. 1 = Very important, 2 = Important, 3 = Less important, 4 = Unimportant). The interpretation of the results was based on number of answers per category[1].

Environment resources and appropriate media

Concerning the environment resources and appropriate media at the partner institutions the results show that the respondents have adequate digital competences. There is also a basic understanding of E-Learning in classroom settings. However, it is evident that E-Learning and blended learning have not yet been strongly focused in the metal sector and there is a need for development in this area.

Regarding learning platforms which are appropriate for the metal sector, the answers suggested (in decreasing order) the following:

- Moodle
- ILIAS
- Blackboard
- Canvas
- Accord LMS
- Learning Space
- Schoology
- Other: It´s Learning, Office 365

Additionally, the respondents recommend the following didactic materials that are important for online teaching in the metal sector (in decreasing order):

- Best practice examples from enterprises
- Videos
- Worksheets as WORD documents or PDF
- Graphics and illustrations
- Quizzes

[1] The exact results can be found in the EDU-VET Summary Research Report.

- Blended learning scenarios
- Interactive tasks
- Single choice or multiple choices questions
- Learning programmes / software
- OER (Open educational resources)
- Audios
- Online courses
- MOOCs (Massive open online courses)

Estimations about digitisation and E-Learning/ blended learning courses

Another question refers to the estimations about digitisation, E-Learning and blended learning courses. In the following a summary of the responses of all participants will be shown.

Concerning the estimation about digitisation it was agreed that digitisation is very important, interesting, motivating, innovative, helpful, useful and necessary. Moreover, some respondents state that it is sometimes not so easy to implement digitisation in the learning and teaching process.

Concerning the estimation of E-Learning in the metal sector the results are quite similar to the items before. However, at this point the majority expresses reservations about using E-Learning in the teaching and learning process. However, the majority of the respondents think that E-learning is also very important, interesting, motivating, innovative, helpful, useful and necessary.

Concerning the estimation about blended learning courses in the metal sector you can see that there is a very similar picture of the results as in the previous question. There are also concerns in this context in using blended learning courses in the teaching and learning process. However, the majority of the respondents express that blended learning is also very important, interesting, motivating, innovative, helpful, useful and necessary.

Appropriate assessments

This question field refers to appropriate assessments in online environments in the metal sector.

Analysis of the answers supported us to conclude that the most appropriate assessment for E-Learning or blended learning for the implementation of the EDU-VET curriculum should be: (1) Practical tasks (2) Video creation (3) Ordering tasks (4) Audio/ podcast creation (5) Mind maps/concept maps (6) Wall paper/posters (7) Formative assessments (8) Summative assessments.

Additionally, analysis of the answers supported us to conclude that other types of assessment are more appropriate for E-Learning or blended learning for the implementation of the EDU-VET curriculum should be: (1) Class test (2) Writing tasks (3) Oral assessments (4) Realistic/ authentic problem (5) Online question tests (6) Presentations (7) Interactive tasks (8) Case study (9) Diagnostic tests (10) Other: Practical examination in a workshop, Workshop audit.

Opportunities and Challenges

The last part of the questionnaire addresses opportunities and challenges of Digitisation and E-Learning. At this point it is an open response format. Following, we address the summarised results.

Opportunities of digitisation and E-Learning in the metal sector:

- Online teaching and learning is possible
- Flexibility
- Immediate communication
- Independence of place and time
- Sustainable learning and teaching
- Consolidation of teaching and learning materials
- Easy way to learn
- Attractive and modern way for learning and teaching
- Structured teaching
- Quick communication between pupils, but also pupils and teachers e.g. via chat, forums
- Additional applications such as chat etc.
- Attractiveness of learning content
- Increase of teaching and learning motivation
- Control of own learning pace
- Individualization of the learning process

Challenges of digitisation and E-Learning in the metal sector:

- Cost/benefit
- High training time
- Financial resources
- Observance of data protection
- Continuous training necessary
- Lack of digital skills among pupils and teachers
- High training costs
- Often no end devices for pupils
- Intensive support and supervision of pupils (cf. EDU-VET SUMMARY RESEARCH REPORT 2020).

Ingenious Knowledge did not provide data from the field research. Above, there you can see the presentation of the results from the specific research performed by the project partner

Ingenious Knowledge (IK) regarding the best practice e-learning environments and best practice mini-learning format resources to be used in designing the proposed curriculum.

Best practices in the design and production of mini-learning-format teaching resources

With regard to effectiveness of the design of online courses following points should be considered:

- They are grounded in an understanding of the learning process.
- They are based on the needs of adult learners.
- They link theory and practice.
- They accommodate range of learning styles.
- They are accessible.
- They are "flexibly" designed.
- They offer flexible delivery.
- They provide for flexible assessment.
- They use a variety of media.
- They are interactive. (cf. BURNS 2016)

In this context, there are six principles of good graphic design – contrast, similarity, proximity, alignment, symmetry and repetition – that should be applied when building a course (cf. IBID.).

When designing e-Learning, repeating key points helps the learner to remember and associate these points and the new information presented together. This principle is called 'scaffolding.' This is also an important element of graphic design within eLearning because it allows the learner to anchor key information together (cf. COLMAN 2020).

Concerning mini- or micro-learning format many variants will be used, e.g. short learning videos, playful elements such as a quiz (keyword: gamification), clear infographics, digital flashcards or interactive elements. These various forms are also appropriate for EDU-VET and will be also included on the EDU-VET learning platform. Moreover EDU-VET intends to combine the elements above.

The art to any effective e-Learning is to make it people-centred. In this context, we can accentuate following points regarding the development of the learning modules, which are also based on the answers of the interviewed respondents. That is also the reason why we follow the following points in the development of the learning modules within EDU-VET:

1. Enable mobile access
2. Focus on one idea per module
3. Use relevant visuals and media
4. Offer customization

5. Keep it lean

Best practices in the design of e-Learning environments

Another research part is the research of best practices in the design of e-learning environments. Based on the literature (cf. SCHEIN 2004) and the field-based research IK proposes the following basic framework for developing e-Learning environment according to EDU-VET. The table below focusses on these research results:

Instructions for Use	-Write a brief description of the topic at the beginning of a learning session -Clarify the learning goals/ learning outcomes -Mention the approximate total period of time required to complete the whole session (including reading tasks, videos, quizzes, participation, etc.) -Provide the students with a To-Do-Lists. This guides them to accomplish the session step by step -Consider Checklists at the end of each session. Checklists help students with self-evaluation and self-improvement -Set other rules clearly -Always, write instructions in an easy language
Content Presentation	-Identify clear learning objectives -Prepare consistent and structured content -Simplify what you explain or show -Use various types of learning activities and digital materials (e.g. audio, short video, slide-show, PDF, text, link to a website, etc.) -Employ the right material for the right context (e.g. sometimes reading a file is better than listening to an audio) -Make the materials accessible for online and offline uses
Knowledge Testing	-Create tasks for the students to assess their own learning -Make sure that the tasks are relevant to the content and the learning objectives -Provide feedback (e.g. immediate automatic feedback)

Engagement	-Communicate with learners more often than you do in seminars (E.g. regular emails and reminders, information in a forum) -Foster teacher-student and student-student interactions (asynchronous and synchronous communication) -Personalize your profile (on Moodle). Upload a profile picture and write something about yourself. Advise your students to do the same! This creates a friendly online environment. -Encourage students to build up virtual study groups to support each other -Consider feedback exchange

Table 1: Best practices in the design of e-Learning environments
Source: EDU-VET SUMMARY RESEARCH REPORT (2020, p. 19).

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7. The EDU-VET Curriculum VET curriculum and the use of new media in metal VET

Jana Stelzer / Andree Wendering

The following chapter offers initial insights into the EDU-VET curriculum and module structure. First of all, basic approaches will be presented. Following this, this section illustrates insights into the EDU-VET Blended-Learning approach and the didactic and curricular conception of the modules and the LOMs. Finally, further information is provided about the development of learning materials for online courses, described through examples of tasks created via the H5P platform.

7.1 Basic approaches of the EDU-VET Curriculum

In addition to the necessary competences, further competences operate as a fundamental framework concerning the EDU-VET Curriculum and course development. These key skill areas are discussed in detail below.

Technical competence (professional competence)

This competence refers to the willingness and the ability to solve tasks and problems in a goal-oriented, appropriate, method-guided and independent manner on the basis of professional knowledge, as well as the ability to assess the results. In this context, the trainees are required to have basic knowledge in mathematics and technical aspects (cf. KMK 2002).

Action competence

Here, the focus is on decision-making and assuming responsibility with regard to the tasks. Action competence is developed within the dimensions of professional competence, personal competence and social competence (cf. IBID.).

Personal competence

This refers to the willingness and the ability of an individual to clarify, think through and assess the development opportunities, requirements and limitations in family, work and public life, to develop his or her own talents and to make and develop life plans. It includes personal qualities such as independence, critical faculties, self-confidence, reliability, a sense of responsibility and duty. In particular, it also includes the development of well-thought-out values and a self-determined attachment to values (cf. IBID.).

Social competence

Social competence refers to the willingness and the ability to conduct social relationships and to shape, grasp and understand possibilities and tensions and to discuss and communicate with others in a rational and responsible manner. In particular, this includes the development of social responsibility and solidarity (cf. IBID.).

Methodological and learning competence

Knowing, analysing and applying suitable methods for the learning process is an important set of competences. These competences grow from a combination of the above-mentioned competence areas (cf. IBID.).

As well as fostering the aforementioned competences, the integration of syllabus objectives for VET learners in the metal sector is also relevant. The objectives of the syllabus for VET learners in the metal sector should be realised according to the development of the curriculum as well as through online and face-to-face learning courses. Furthermore, the partners should follow the didactic principles by creating the curricular framework.

In concrete terms, the objectives of VET require that instruction should be related to action (cf. KMK 2020). That means that young people should learn to plan, carry out and evaluate tasks independently within the framework of their occupation. Learning at vocational school occurs in relation to professional action as well as various cognitive operations (cf. IBID.).

On the basis of learning theory and didactic findings, the pragmatic approach to the design of action-oriented teaching is as follows:

- Didactic reference points are situations that are important for carrying out the profession (learning for action).
- The starting point of learning is formed by actions, if possible carried out by the learner or mentally understood (learning by doing).
- Actions must be planned and carried out by the learners as independently as possible, and have to be checked, corrected if necessary and finally evaluated.
- Actions should promote a holistic understanding of the professional reality; for example, technical, safety, economic, legal, ecological and social aspects must be included.
- Actions must be integrated into the learners' experiences and be relevant to their social context.

Actions should also include social processes, such as the declaration of interests or conflict resolution. Action-oriented teaching is a didactic concept which is based on intertwining subject-specific and action-systematic structures. It can be realized through different teaching methods (cf. IBID.).

7.2 The EDU-VET Blended Learning approach

The EDU-VET Blended-Learning approach offers new possibilities to rethink VET in the metal industry and enhances the access of the learners to training and qualifications. This is the reason why in the context of EDU-VET VET schools and enterprises cooperate to meet the economic needs of practice and the world of work. It is crucial to have a strong and relevant curriculum as a basis for EDU-VET which ensures quality and provides both structure and learning tips for VET teachers, VET educators and learners.

With reference to KERRES, the Blended-Learning approach is defined as "[…] a combination of media-supported learning with face-to-face elements in learning arrangements" (KERRES 2018, p. 23). KERRES & DE WITT provide a more differentiated definition. They understand Blended-Learning, based on DRISCOLL, primarily:

> "to combine different web-based technologies,
>
> - to combine different pedagogical approaches,
>
> - to combine any form of instructional technology with FTF instructor led training or / and
>
> - to combine instructional technology with actual job tasks in order to improve learning transfer" (KERRES / DE WITT 2003, p. 2).

The EDU-VET Blended-Learning approach is separated into two parts: the online scenario and the classroom scenario.

The online scenario refers to the development of online courses and materials which will be provided via the online learning platform. It also includes interactive tasks and videos as well as audios, photos, images and illustrations. The use of the survey module provides a variety of tested questionnaire instruments in order to discover relevant information about the EDU-VET target group. The task creation is completed through the H5P platform.

Concerning the classroom scenario, the partners have to create courses and content for face-to-face classrooms lessons. Additionally, existing methods can be used, such as group work, discussions, creating a poster, working in the workshop and on the machine, building a model,

simulations etc. The partners could also create additional didactical materials which can be used in the classroom in combination with the online platform.

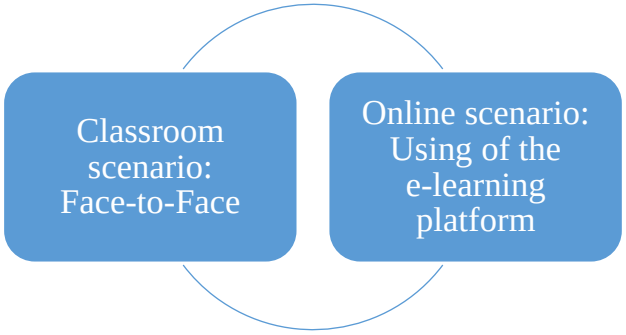

Figure 10: The EDU-VET Blended-Learning approach
Source: Own representation according to EDU-VET CURRICULUM (2020).

In addition, the objectives for authentic learning in the EDU-VET Blended-Learning scenario are as follows:

(1) EDU-VET takes the learner´s/person´s qualifications and interests into consideration and offers learning modules and courses that fit the needs and the curricular structures of EDU-VET and their partner countries.

(2) EDU-VET provides scientifically sound concepts as well as teaching and learning resources.

(3) EDU-VET offers high quality OER.

(4) EDU-VET is relevant to partners in the metal industry where blended learning on the basis of learning platforms is currently not state of the art.

(5) EDU-VET offers modern learning approaches and considers the potential of digitisation for the educational sector.

(6) EDU-VET is sustainable. The EDU-VET approach will be completely transparent. It can be developed further and will also provide a sound foundation for future work. The implementation of EDU-VET and the activities of the partners will ensure that the curriculum, the courses and the handbook will be used in the daily work of VET teachers.

(7) EDU-VET potentially brings young, disadvantaged people in contact with knowledge which is relevant to the needs of economy in the metal sector.

(8) EDU-VET can grow and diversify. In contrast to currently available eLearning approaches, EDUVET offers the advantages of traditional modules and foci can also be integrated easily after the end of the project duration.

(9) EDU-VET integrates the idea of authentic learning.

In summary, the Blended-Learning approach serves as the basis for the curriculum. Therefore, the following graphic illustrates the EDU-VET curricular framework:

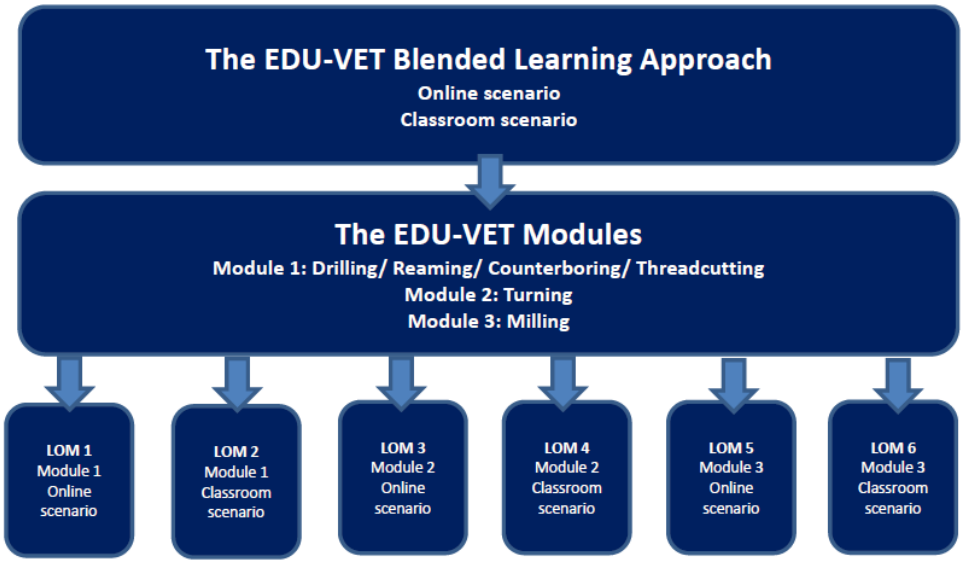

Figure 11: The EDU-VET curricular framework
Source: Own representation according to EDU-VET CURRICULUM (2020).

7.3 The EDU-VET Learning Outcome Matrices

The modules and the Learning Outcome Matrices (LOMs) are designed with reference to the EDU-VET Blended-Learning approach. A modular VET curriculum for the metal industry will be developed as a basis for the online courses and learning modules on the learning platform. The aim is to support the acquisition of key high-value competences which are necessary for establishing modern and innovative learning in the field with a European focus. As mentioned above, the development of this new curriculum will require an 'ab initio' approach as there is little in terms of available systematic educational resources addressing the target groups in any partner country.

The six Learning Outcome Matrices of EDU-VET (LOM1 to LOM6) provide insights into the addressed outcomes, suggested methodological approaches and possible assessments. The Learning Outcome Matrices are designed to inform about the development of the curriculum structure and to integrate the results of the Summary Pedagogic Research Report. Focusing on a learning outcome approach facilitates the tailoring of the pedagogical induction resources.

This provides the opportunity to adapt to specific cultural and societal values and ensures that local issues as well as necessary factors are addressed within the EDU-VET approach.

The EDU-VET modules for VET learners will be addressed in the EDU-VET Curriculum. These modules are based on the research conducted in each partner country. As mentioned in the previous section, EDU-VET focusses on three modules and several sub-sections for learners:

Module 1: Drilling/ Reaming/ Counterboring/ Thread cutting

- Fundamental definition of terms and processes
- DRCT-Part _1: small diameters/low bore depth (flat) bores of different types: blind/through bores, fitting bores, tapered bores (steps a-f)
- DRCT-Part_2: medium diameters/medium depts bores of different types: blind/through bores, threaded bores, counterbores (steps a-f)

Module 2: Turning

- Fundamental definition of terms and processes
- TURN-Part_1: Simple external contour (steps a-f)
- TURN-Part_2: Medium complex external contour with groove and thread (steps a-f)
- TURN-Part_3: Simple internal contour (steps a-f)
- TURN-Part_4: Medium complex internal contour with groove and thread (steps a-f)
- TURN-Part_5: Medium complex external- and internal contour with grooves and/or threads (steps a-f)

Module 3: Milling

- Fundamental definition of terms and processes
- MILL-Part_1: simple external contour (2 1/2D) (steps a-f)
- MILL-Part_2: medium complex external contour (2 1/2D) (steps a-f)
- MILL-Part_3: simple external contour and one or more pockets (rectangular and/or circular pockets
- with and/or without pin) (2 1/2D) (steps a-f)
- MILL-Part_4: medium complex external contour and one or more slots (linear and/or arced slots) (2
- 1/2D) (steps a-f)
- MILL-Part_5: medium complex part (3D) (steps a-f)

For all the different work piece types and the three different manufacturing methods (DRCT, Turning, Milling) the manufacturing process comprises the following six steps (a-f):

- Step a: Manufacturing planning (defining the machine(s), device(s), tool(s) and cutting technology
- Step b: NC programming (including simulation)
- Step c: Preparing the machine (including testing of NC-programme on the machine "air cutting")
- Step d: Manufacturing the work piece (complete the actual work task)
- Step e: Measuring and testing the manufactured work piece (dimensions, forms, surfaces)
- Step f: Documenting and presenting the manufacturing process (steps a-f)

The modules are depicted below as a graphic:

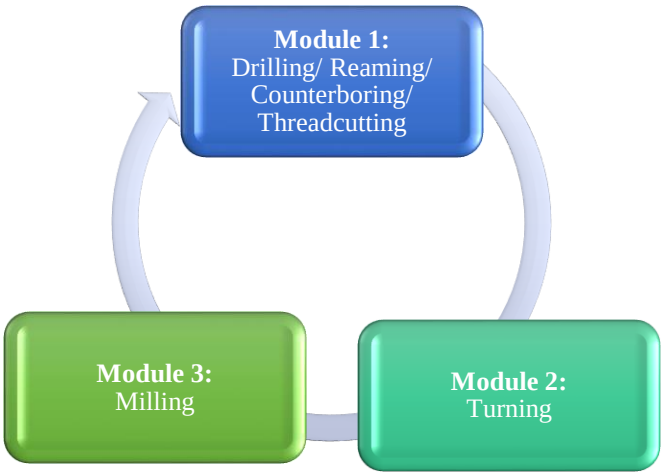

Figure 12: The EDU-VET modules for learners
Source: Own representation according to EDU-VET CURRICULUM (2020).

The following six LOMs were derived from the modules which are the result of the research of the EDU-VET partners and the Blended-Learning approach.

There are three LOMs for each of the three modules. Moreover, these modules can be divided into presence and online scenarios, which results in six LOMs in total.

- LOM1 addresses Module 1 (Drilling/ Reaming/ Counterboring/ Thread cutting) for an online scenario.
- LOM2 addresses Module 1 (Drilling/ Reaming/ Counterboring/ Thread cutting) for a classroom scenario.
- LOM3 addresses Module 2 (Turning) for an online scenario.
- LOM4 addresses Module 2 (Turning) for a classroom scenario.

- LOM5 addresses Module 3 (Milling) for an online scenario.
- LOM6 addresses Module 3 (Milling) for a classroom scenario.

The Learning Outcome Matrices address young people who are learners in the field of VET in the metal sector.

The following figure shows an example for LOM1, which refers to Module 1 (Drilling / Reaming / Counterboring / Thread cutting) and the online scenario:

Learning Outcome Matrix: Module 1 (Drilling/ Reaming/ Counterboring/ Threadcutting) - Online scenario (LOM1)

	Outcomes	Teaching and Learning activities	Assessment
	Having taken this induction/ course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning-activities:**	**The learners will be assessed on their achievement of this specific outcome through the following assessment-tasks:**
Introductory level (12-14 years)	understand the main aspects and processes and definitions of Drilling/ Reaming/ Counterboring/ Threadcutting.	The learners will get informed by a ppt presentation which provides an overview concerning the topic of Drilling.	An online task via H5P and a short evaluation questionnaire is main basis of assessing the right understanding of Drilling.
Intermediate level (14-16 years)			
Advanced level (16-18 years)			

Figure 13: Example for a LOM (LOM1)
Source: Own representation according to EDU-VET CURRICULUM (2020).

7.4 Didactic und curricular conception of the EDU-VET Learning Modules

The EDU-VET curriculum formed the basis for the creation of the teaching and learning materials as well as for the modular blended learning course design by means of Learning-Outcome Matrices, in which classroom and online offers are deliberately combined and systematically interlinked. Since this should be more than a mere juxtaposition of offers, an online showroom with insights into metal companies and best practice information as well as company pictures and videos was also created for teachers in order to provide teachers and learners with a uniform, common basis of authentic insights and experiences in company contexts, which goes beyond the individual company-specific experiences of the individual learners and is able to provide a basis for practice-oriented exchange in the vocational school context. In order to provide teachers with a basis for dealing with these new digital offers, the learning modules were structured in different levels, which are graded according to difficulty and complexity: (a) entry level, (b) advanced level and (c) experienced level (cf. BEUTNER

2020). Under this roof, a fundamental structure of the EDU-VET learning modules will be developed. This structure was adjusted in the course of the project, but it serves as the basis for the module framework:

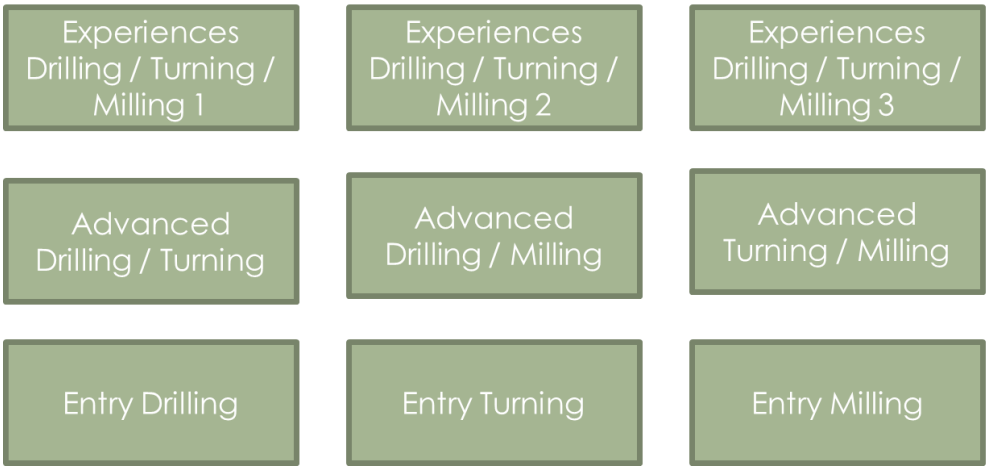

Figure 14: Fundamental structure of EDU-VET Learning modules
Source: Own representation according to EDU-VET CURRICULUM (2020).

At the entry level, the focus is on simpler problem situations, each of which is dedicated to only one of the three subject areas, drilling, turning and milling, resulting in three learning modules at the entry level. At the advanced level, problem situations of product design are included that require the combination of two areas in each case. Thus, a module is developed in which drilling and turning must be implemented together on the product, a module in which drilling and milling are necessary together on a product and a module in which turning and milling must be used together on a final product. At the experienced level, three modules are also developed with problem situations in which all three areas are equally necessary in the implementation. This enables the teachers to use the modules in different metal professions and with different previous knowledge of the learners (cf. BEUTNER 2020).

For all the different work piece types and all three different manufacturing methods (DRCT, Turning, Milling) the manufacturing process comprises the following six steps (a-f):

- Step a: Manufacturing planning (defining the machine(s), device(s), tool(s) and cutting technology
- Step b: NC programming (including simulation)
- Step c: Preparing the machine (including testing of NC-programme on the machine „air cutting“)
- Step d: Manufacturing the work piece (doing the real thing)

- Step e: Measuring and testing the manufactured work piece (dimensions, forms, surfaces)
- Step f: Documenting and presenting the manufacturing process (steps a-f)

The EDU-VET Curriculum structure and content – the fundamental pillars of the EDU-VET Curriculum

The EDU-VET curriculum aims to support many different users in different European countries – this shall be made possible by integrating the specifically different viewpoints of the four EDU-VET partner schools.

The following design principles should help to meet this objective:

- The curriculum is primarily structured by the process steps of the *„EDU-VET manufacturing process model"* in the format of an event process chain. Thus, there is a first trans-national and trans-school-system applicable integration means.
- Secondarily the curriculum is structured by the skill levels of the „*EDU-VET curriculum skill level model"*. This allows the assignment of the learning units to different student groups according their state of development.
- Thirdly the EDU-VET curriculum and learning units shall be easily integrated with the user's local curriculum and learning units, therefore the *„EDU-VET curriculum learning unit model"* distinguishes different learning unit types and learning unit variants.
- *Finally,* the learning units of the EDU-VET curriculum are classified regarding delivery media and learning activity type in order to support the users in the process of delivery preparation and student orientation.

The EDU-VET Process Model

The *EDU-VET Process Model* describes a manufacturing process. An event initiates the execution of a process step. The execution of the process steps leads to the events of step is completed and step outcomes are ready.

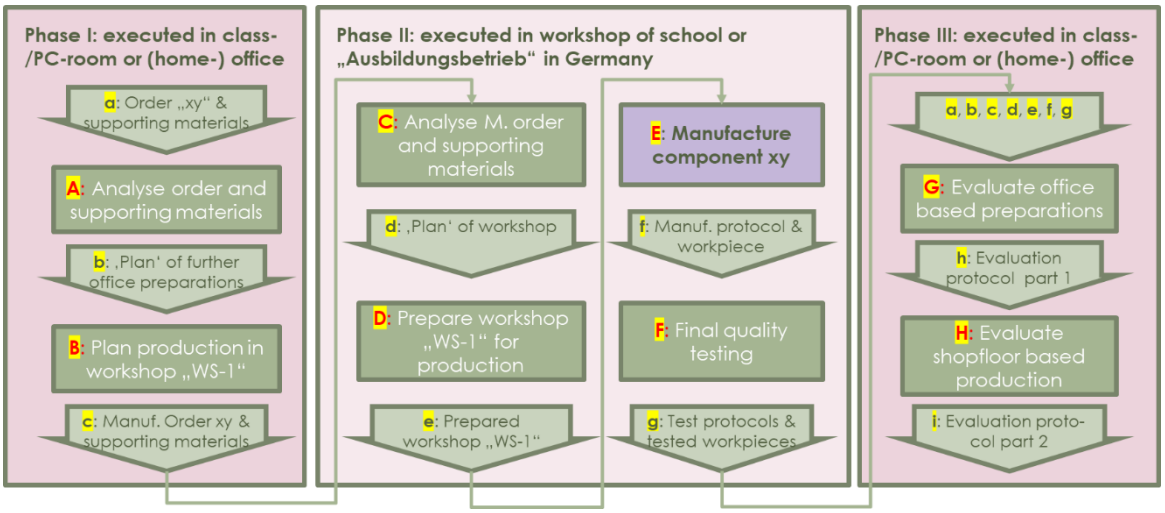

Figure 15: The EDU-VET Process Model
Source: Own representation according to EDU-VET CURRICULUM (2020).

The EDU-VET Curriculum Skill Level Model

The EDU-VET Curriculum Skill Level Model comprises three different skill levels distinguished by the complexity level to be handled on each skill level. Four sources drive the complexity. The EDU-VET curriculum skill level model is also linked to the difficulty levels of the EDU-VET learning modules.

Skill Level	Complexitiy Level	Complexitiy drivers
Entry Level	Low Complexitiy	• **Workpiece properties** (esp. form of raw part and finished part, Machining properties of the workpiece material) • **Manufacturing environment** (qualities and conditions particularly of avalilable machines, tools, devices, auxilliaries) • **Production process and process steps** (number and complexity of production methods / steps / equipments needed respectively planned to create the different workpiece properties) • **Task context and background** (all needed knowledge and information available, all needed resources avaliable – several bits of knowledge and/or information and/or needed resources not available – methods and sources to close those gaps known or unknown resp. available or not available)
Advanced Level	Medium Complexitiy	
Experienced Level	High Complexitiy	

Figure 16: EDU-VET Curriculum Skill Level Model
Source: Own representation according to EDU-VET CURRICULUM (2020).

The EDU-VET Curriculum Learning Unit Model

The EDU-VET Curriculum Learning Unit Model comprises learning units of different types and variants and shall support several different learning unit application types and variants, too. On the one hand, this structure should enable users to combine EDU-VET learning units with

different “local” learning units according to their specific circumstances. On the other hand, this structure enables users to apply the EDU-VET learning units in different innovative ways according to their specific circumstances. Moreover, the EDU-VET curriculum learning units are classified regarding delivery media and regarding learning activity type, this creates four basic types (cf. EDU-VET CURRICULUM 2020).

Based on these approaches, we can we can differentiate three fundamental pillars:

- Pillar 1) EDU-VET Process Model
- Pillar 2) EDU-VET Curriculum Skill Level Model
- Pillar 3) EDU-VET Curriculum Learning Unit Model (cf. EDU-VET CURRICULUM 2020).

In summary, this means, that behind each module lies a process-oriented approach that takes into account

(a) the procurement of the necessary materials,

(b) the production planning in face-to-face lessons,

(c) the material provision,

(d) the work planning,

(e) the product implementation,

(f) the quality inspection in the school workshop or the training company,

(g) the evaluation of the preparations and (h) the production itself and specifies respective action results (cf. BEUTNER 2020).

As a result, the following module structure can be developed:

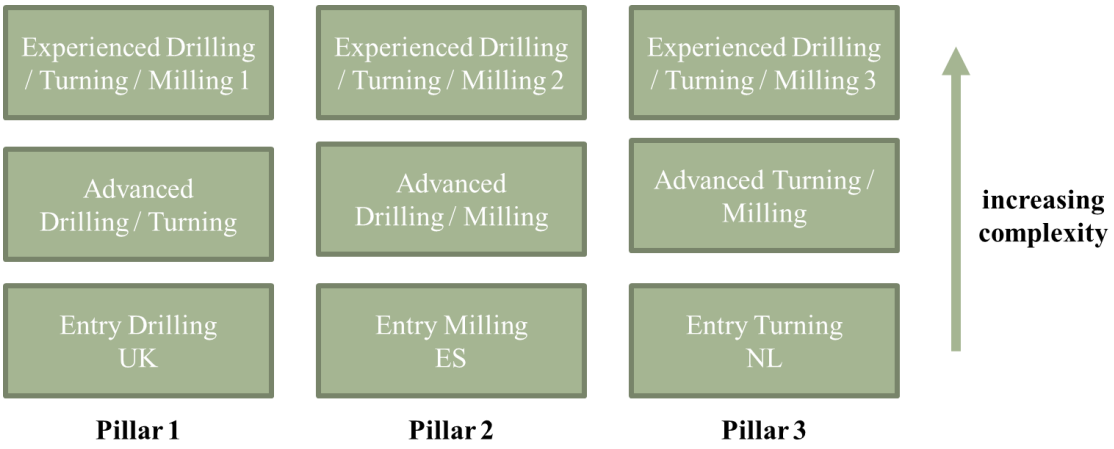

Figure 17: EDU-VET Learning Modules
Source: Own representation according to EDU-VET CURRICULUM (2020).

The implementations show that the work piece properties, the production environment, the actual production process and the process steps that occur, as well as the task contexts and the provision of information and prior knowledge can be identified as complexity drivers.

7.5 Developing interactive learning materials for online courses – insights into H5P content

As mentioned before, Intellectual Output 3 focuses on the development of interactive learning materials for online scenarios. It includes interactive tasks and videos as well as audios, photos, images and illustrations.

In EDU-VET the course pages provide a core tool for VET teachers and learners which allow them to add, remove and structure activities flexibly. Quizzes and assignments help to structure the courses. At the end of a course or module a general overview is provided to the learners which allows for self-reflection and offers them the opportunity to evaluate their knowledge in the wider context of the whole curriculum. Therefore, the courses and modules are interlinked but designed to fit the needs of the leaners and their own learning paths as well as their learning pace.

Moreover, the partners will create these online tasks via the H5P platform. In total the partners will create at least 80 H5P tasks. Initially, all these tasks will be created in English, and they will then be translated into the languages of the partner institutions (cf. H5P 2020).

The objective of H5P is the creation of new types of digital learning and teaching material. The following section will give an insight into selected task formats. The platform offers approximately 40 different interactive task types, such as multiple-choice questions, gap filling tasks, arithmetic quizzes, word quizzes, image sliders, and so on (cf. IBID.).

Below, four task types are explained in detail. These tasks have already been created within project activities.

Multiple Choice

Regarding Module 1, basic and theoretical knowledge can be tested through multiple choice questions. The image below shows an example in which the learners have to name the correct elements of a machinery manufacturing process. There are four response options. The difficulty is that one or more answers might be correct. After selecting possible answers, the learners can check their knowledge by clicking on the "Check" button. They receive feedback immediately and can see the correct answers. All H5P tasks can be repeated indefinitely depending on the learner's needs. The following H5P tasks is carried out within the Learning Module 1 – Entry Milling.

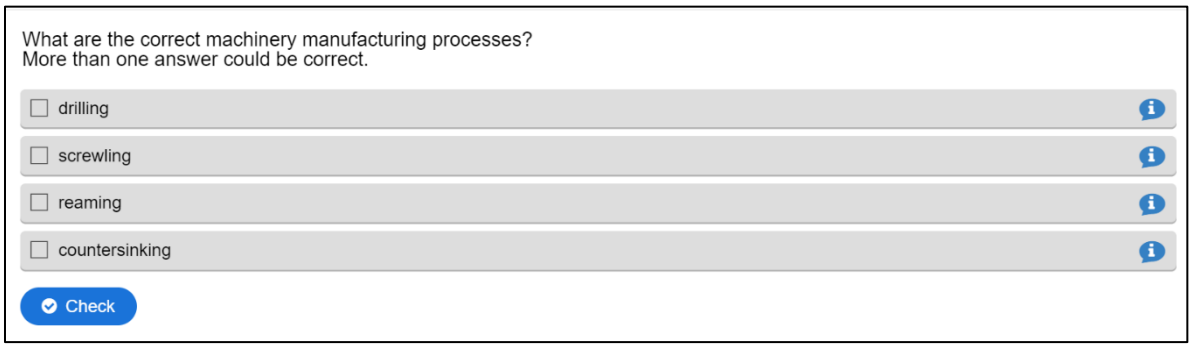

Figure 18: H5P - Multiple Choice
Source: Own representation according to H5P (2020).

Gap filling

As well as multiple choice questions, the interactive task "Gap filling" is also a suitable task for testing basic and theoretical knowledge. Figure 6 gives a first impression of the possibility to check the knowledge taught in module 3, the milling process. The answer options highlighted with a grey box have to be dragged into the blue boxes. One advantage of this task type is that the degree of difficulty can be very easily adapted to the learners' requirements. Moreover, the scope of the task can also vary as required. The learners receive feedback and the correct answer by clicking on the "Check" button. The following H5P addresses the Learning Module 1 – Entry Milling.

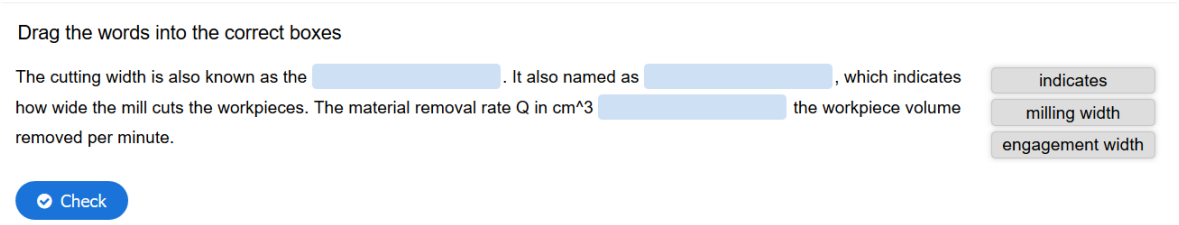

Figure 19: H5P - Drag the words
Source: Own representation according to H5P (2020).

Drag and Drop

The integration of images with H5P offers a wider range of possible tasks which promote concentration and increase learning success. The task type "Drag and Drop" allows the combination of theoretical knowledge with practical examples. The following task refers to Module 2, the turning process. Learners are challenged to correctly label a universal lathe. The answer options provided have to be added via drag and drop and placed in the white boxes on the image. When the learners click the "Check" button they will receive the correct answers and brief feedback. The H5P task below is designed for the entry level.

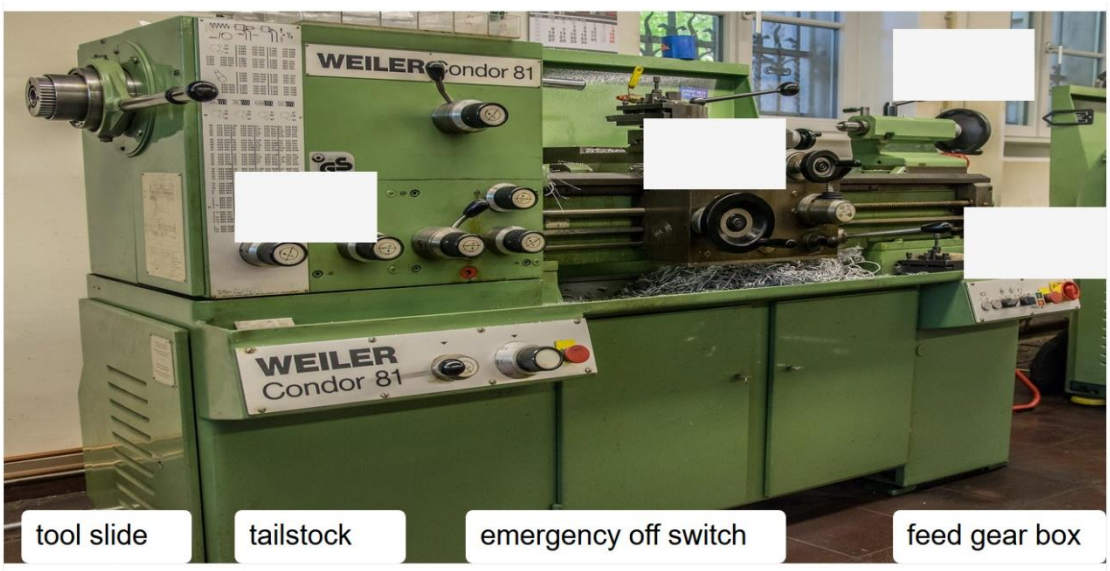

Figure 20: H5P - Drag and Drop
Source: Own representation according to H5P (2020).

Course Presentation

H5P can also be used to integrate learning videos into interactive learning materials. The task type "Course Presentation" allows the embedding of videos and audios. The task below shows an example for turning (Module 2). Within the following task, the learners become familiar with the different tools of the turning processes, and especially the different types of milling cutters. Due to the transmission of knowledge via multiple senses, the video helps the learners to improve their knowledge effectively. The advantage of this task type is that they can watch

it at any time, as often as they choose and can thus learn at their own pace. The following task contains the turning process at the entry level (Learning Module 3 – Entry Turning).

Figure 21: H5P Course Presentation
Source: Own representation according to H5P (2020).

Finally, the examples of H5P tasks represent a fit-for-purpose approach to creating interactive online units for innovative learning processes. The key advantage is that H5P can be easily integrated into other systems such as Moodle or WordPress. As a result, the H5P tasks can be integrated quickly and easily into the EDU-VET platform. Furthermore, the level of difficulty of the tasks can be adjusted. Learners have the opportunity to refresh or develop their knowledge independently at any time and in any place. This provides them with the opportunity to improve their knowledge without the support of teachers or trainers, which is an additional objective of this project. The various task types, combined with immediate feedback, ensure an independent, flexible and successful learning process.

7.6 Developing interactive H5P tasks for online courses in Moodle – a short guideline for teachers

In this context, following there will be a short instruction for developing a H5P tasks in Moodle:

This guideline shows you how you can create interactive H5P tasks on our EDU-VET Learning platform.

1) Firstly, please register on our EDU-VET Learning platform (http://edu-vet.eduproject.eu/) with your login data.

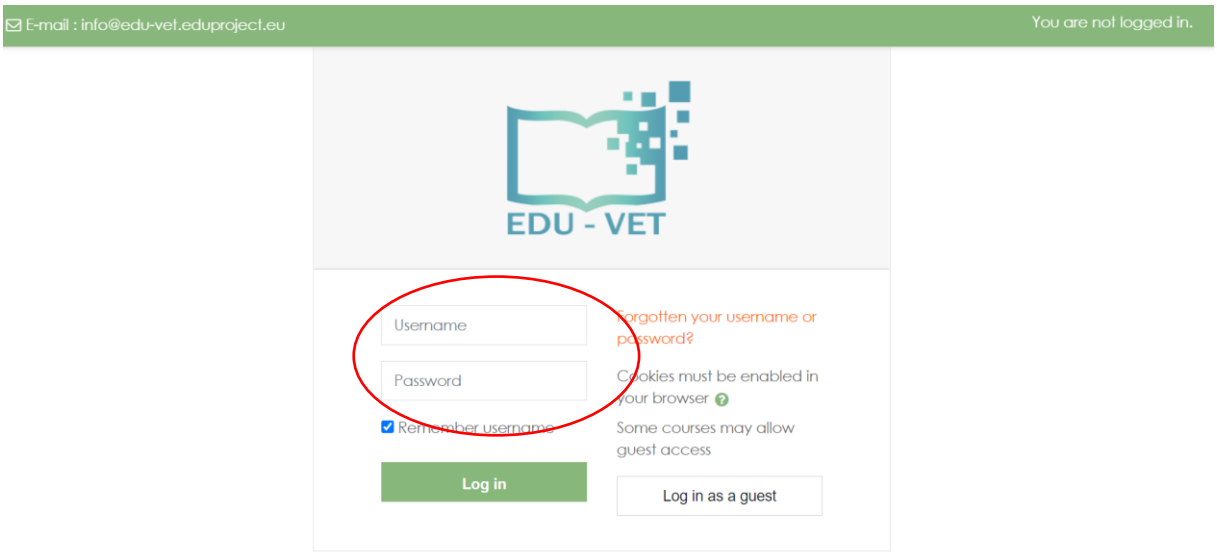

Figure 22: Development of H5P tasks - Step 1
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

2) Afterwards, please choose a Learning Module

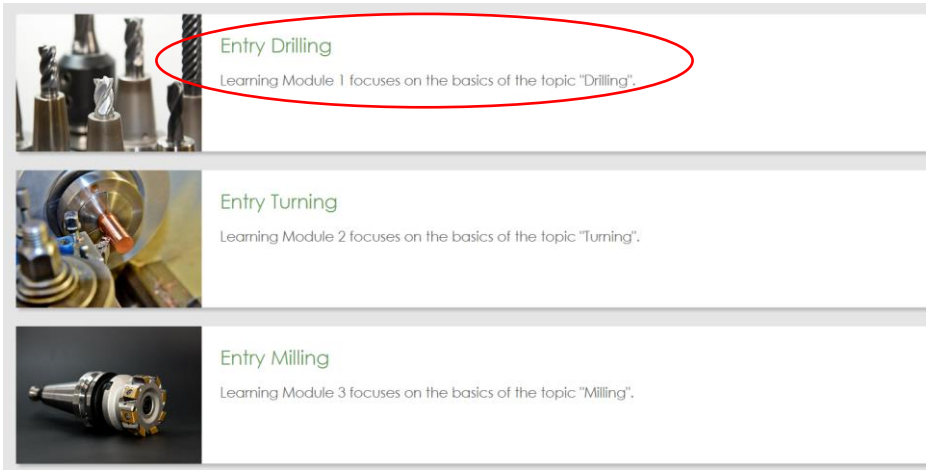

Figure 23: Development of H5P tasks - Step 2
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

3) Please click “Turn editing on”!

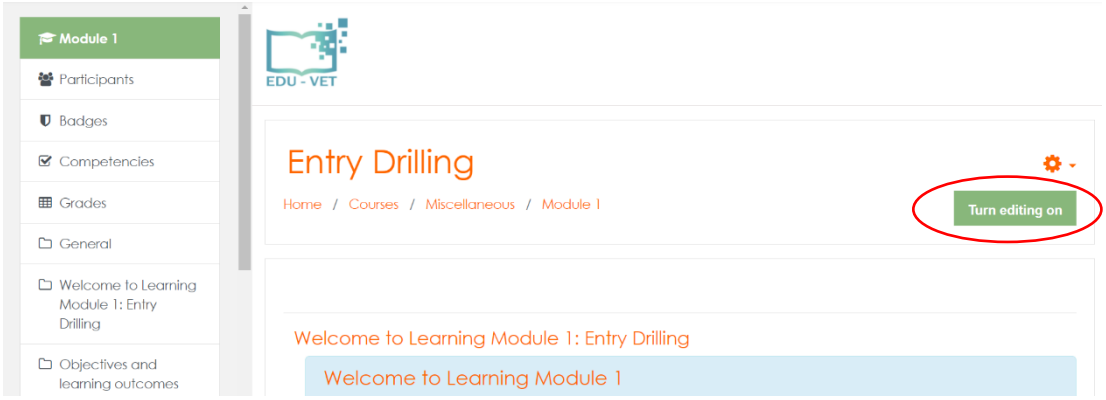

Figure 24: Development of H5P tasks - Step 3
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

4) After clicking “Turn editing on”, the pen and also the function “Add an activity or resource” in green appears. This shows that you are in editing mode. For creating H5P tasks it is necessary to be in editing mode. Please select a tab under which you would like to create the H5P task and click “Add an activity or resource”.

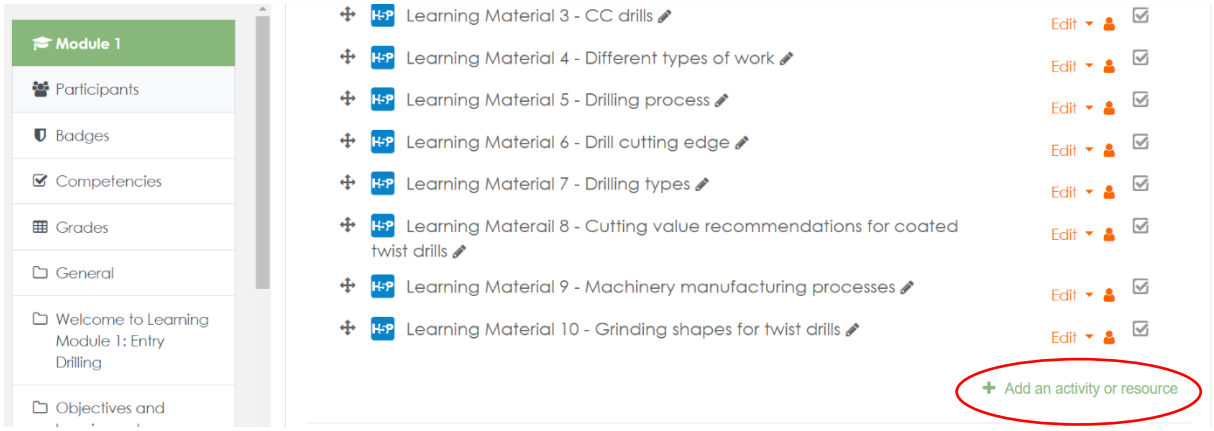

Figure 25: Development of H5P tasks - Step 4
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

5) Please choose “H5P Interactive Content”!

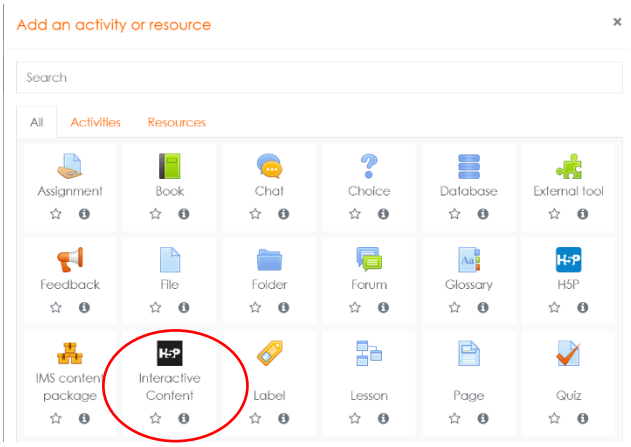

Figure 26: Development of H5P tasks - Step 5
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

6) Afterwards, you see the following screen. It looks like h5p.org we have already worked with. Now you can see all available H5P task types. If some task types are not yet installed, just click “Get” and within a few seconds you can use these task types, too. Otherwise click “Details” for creating a task type.

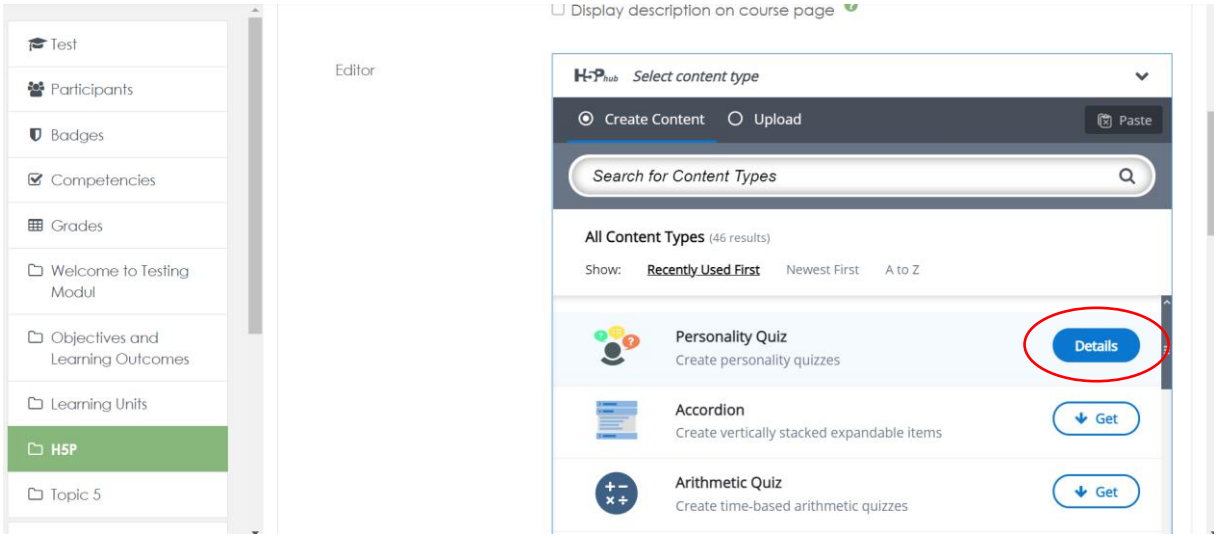

Figure 27: Development of H5P tasks - Step 6
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

7) Then you will receive some general information and explanation about the task type. Either you can watch a Content Demo first, for that you have to click on “Content Demo”. Or you can start the task creation by clicking “Use”.

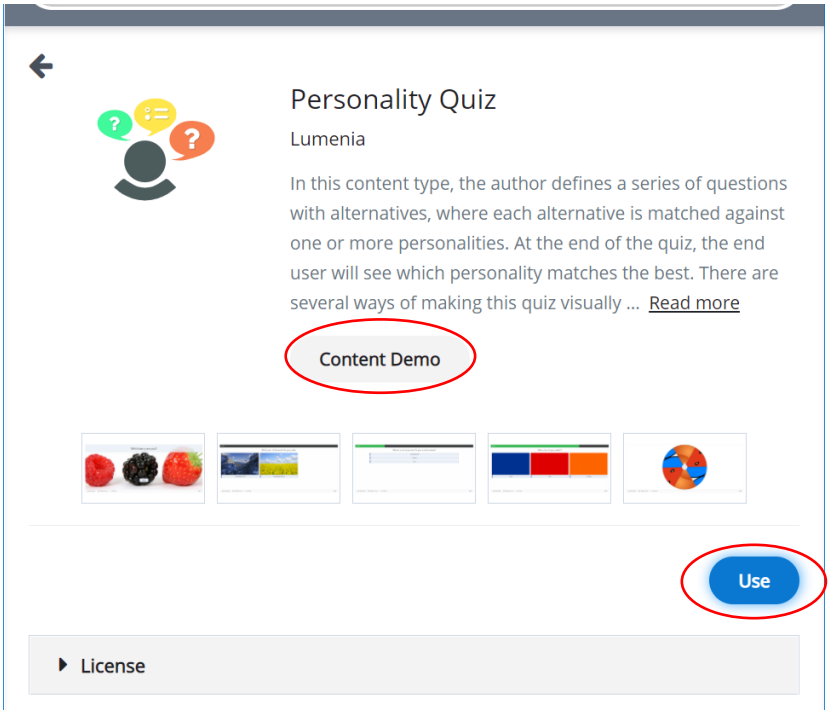

Figure 28: Development of H5P tasks - Step 7
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

8) Start with the task creation by filling in the fields. Please think about the correct description of the title.

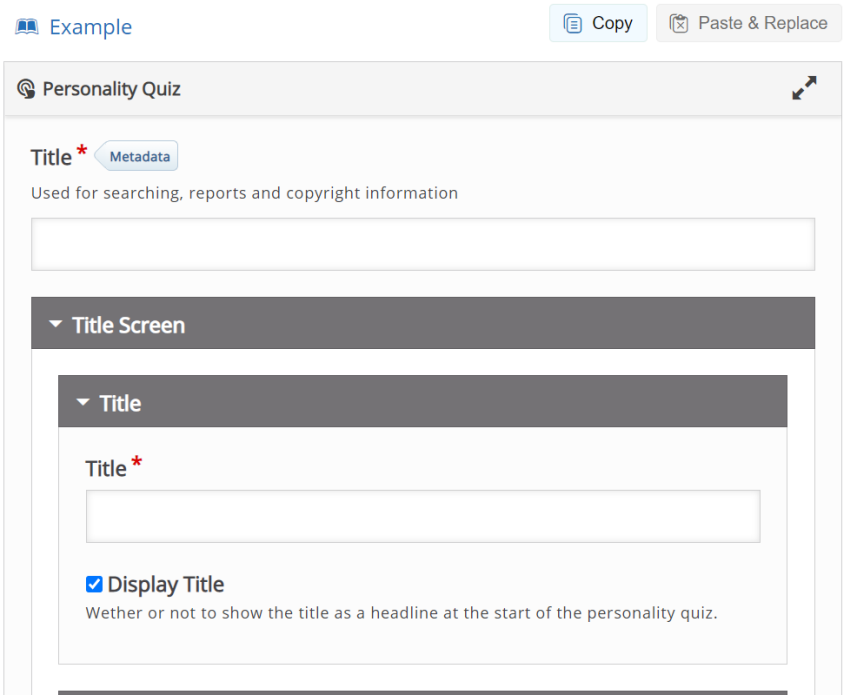

Figure 29: Development of H5P tasks - Step 8
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

9) Finally, save the tasks by clicking “Save and return to course” or “Save and display”. If you click “Save and display”, you can see a preview of the H5P task. Otherwise, you will return to the Learning Module.

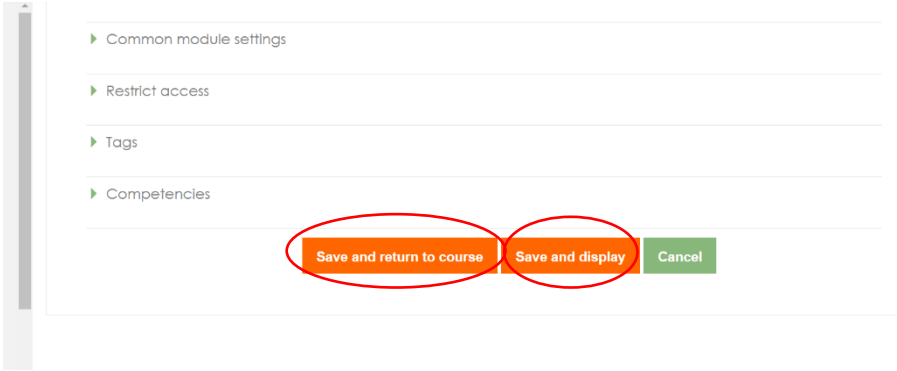

Figure 30: Development of H5P tasks - Step 9
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

10) If you notice that you have made a mistake or would like to change something, click “Edit” and “Edit settings”. Then the task will be displayed again and you can change the contents.

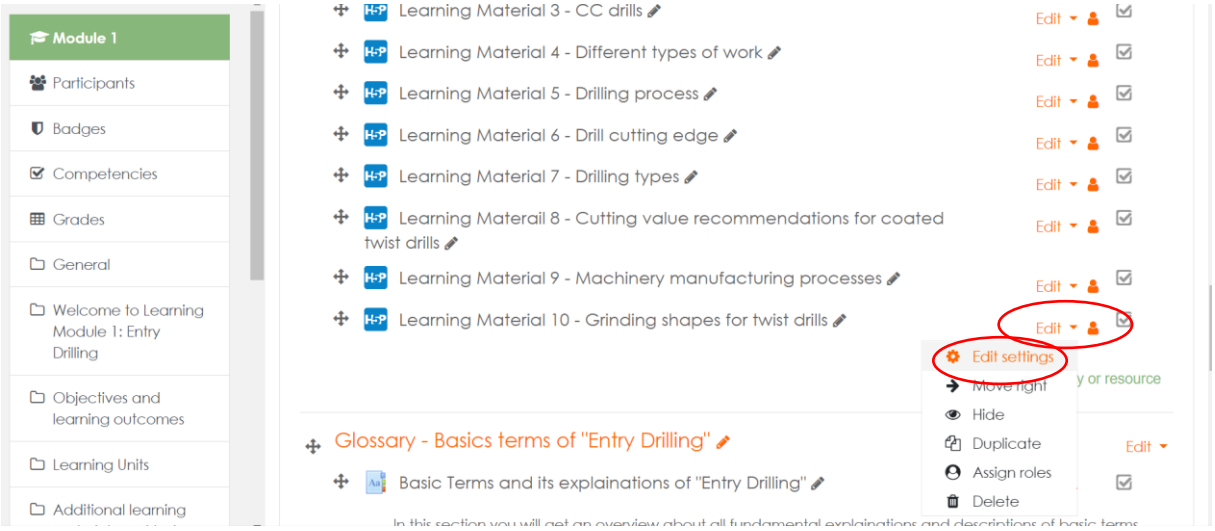

Figure 31: Development of H5P tasks - Step 10
Source: Own representation according to EDU-VET LEARNING PLATFORM (2021).

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8. The EDU-VET learning platform

Rasmus Pechuel

The Learning Tool makes the EDU-VET Learning units available online. It is built on Moodle, one of the most common learning platforms.

Choice of Moodle as a learning platform

Moodle was chosen because most schools are already familiar with it and many even use it as a learning platform. Moodle is open source software which is easily available.

Schools that are interested have the opportunity to copy the contents to their own learning platforms and integrate them with their educational materials.

First Steps

Teachers can integrate the learning units into their educational settings as a way to let learners go through the units at their own pace. The modules offered take the learners from beginner level to intermediate level to advanced level in 3 different topics: drilling, milling and turning. All modules consist of learning input and interactive exercises that give leaners the opportunity to test their knowledge and check if they have understood the content of the module.

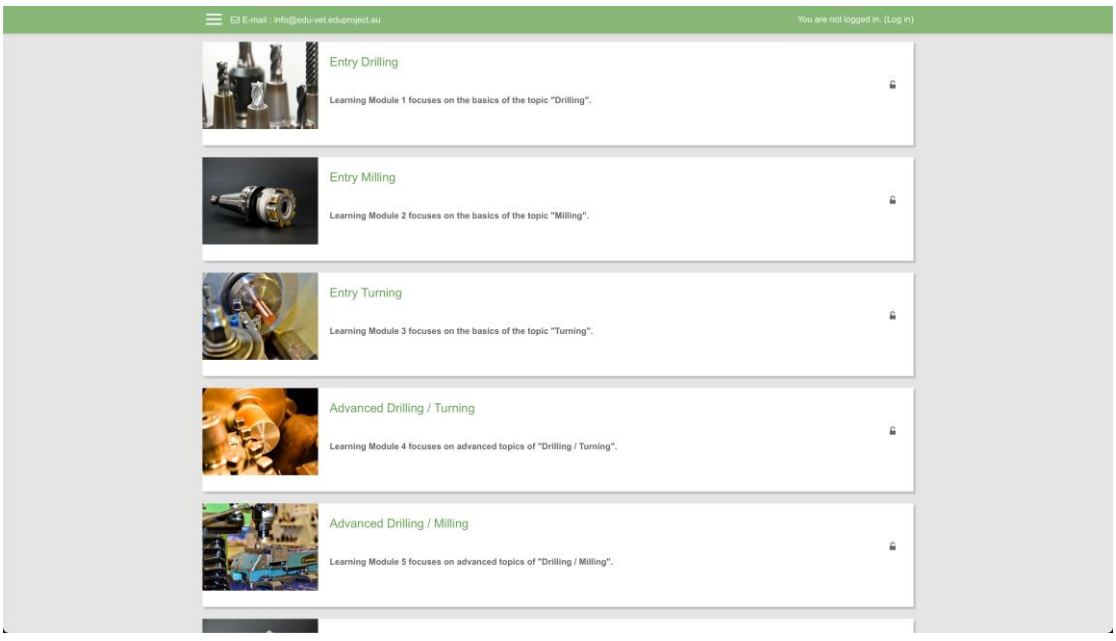

Figure 32: Selection of learning modules
Source: EDU-VET LEARNING PLATFORM (2021).

The quickest way to get started is to choose the desired module in the overview and then choose "guest access" in order to launch the module.

Signing In

Even though Moodle offers sign-in functionality there is no need for this in order to take advantage of the learning modules. Links to the modules can be copied and shared directly in order to make the learning content easily accessible to everyone.

Lesson Overview

The overview page (see below) gives an overview of all the modules available.

It is strongly recommended that learners start with the beginner modules and increase the difficulty gradually.

The overview can be found here:

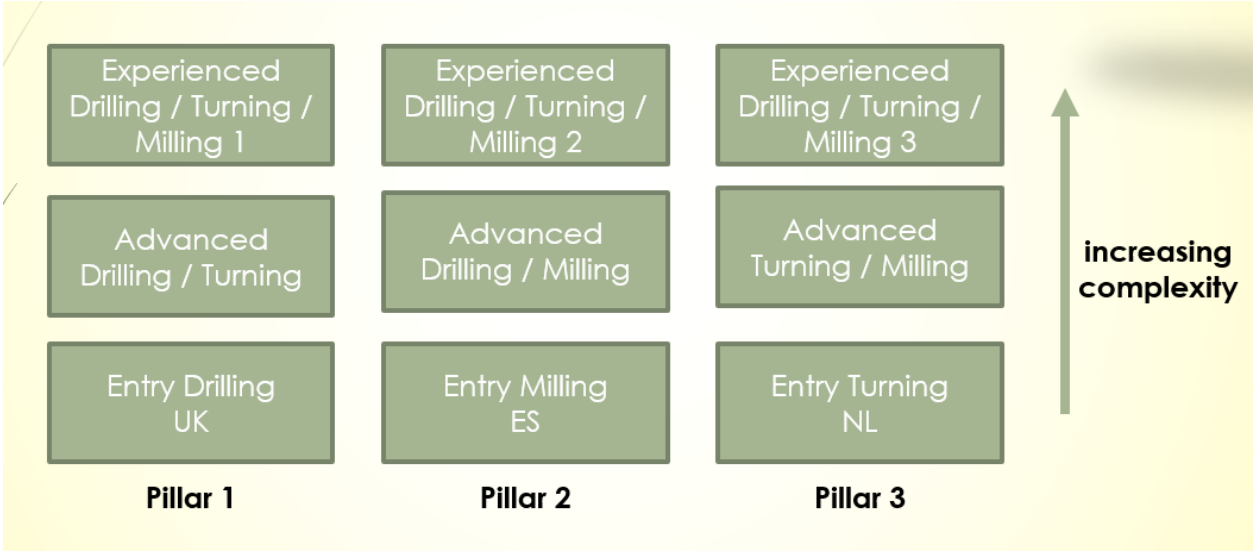

Figure 33: Overview of all learning modules
Source: EDU-VET Learning Platform (2021).

Going through a module

At the beginning of each module learners will see a short introduction text that describes the purpose of the module. They will also be presented with a section on objectives and learning outcomes. Understanding the objectives and outcomes is highly relevant for learners to understand their own learning progress and to make sure that their learning was actually successful at the end of the module.

Each module is divided into smaller sections called Learning Units. Learners can go through modules by clicking/tapping on the next section which appears in the lower right corner of each

page (in green). The lower left corner displays a link that takes the learner to the previous section. In a central position at the bottom of each page is a dropdown menu which lets the learner jump to any section of the module immediately.

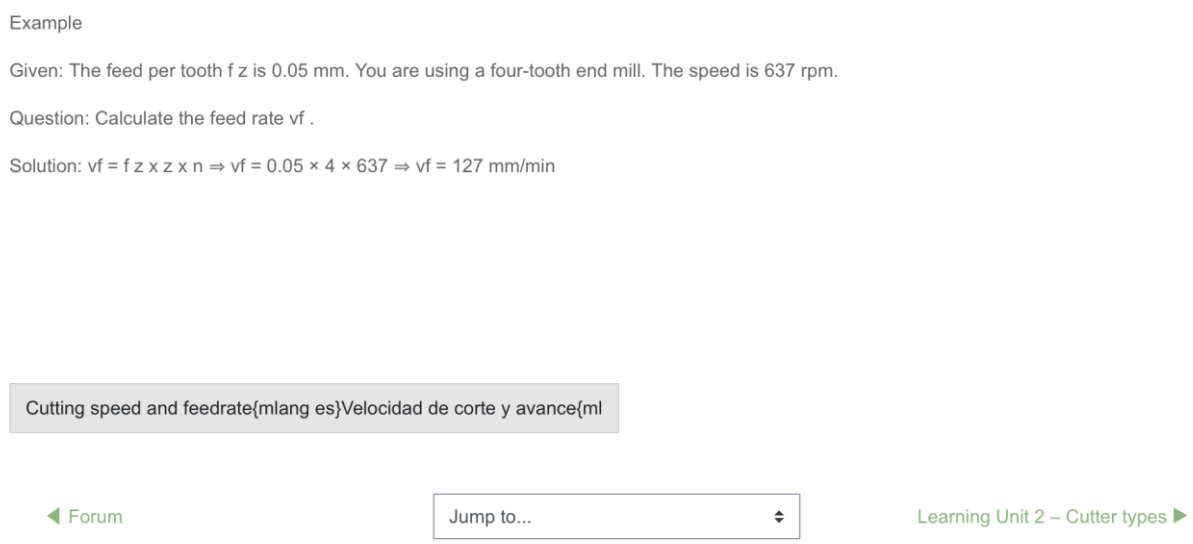

Figure 34: Navigating through a learning module
Source: EDU-VET LEARNING PLATFORM (2021).

These navigation options help learners move back and forth through the learning modules in order to focus on parts that they need to review several times.

Interactive Exercises

All learning modules contain interactive exercises that rely on H5P technology. The exercises give learners an opportunity to test their learning progress. It is highly recommended that learners go through the exercises and review the appropriate sections if their answers were incorrect.

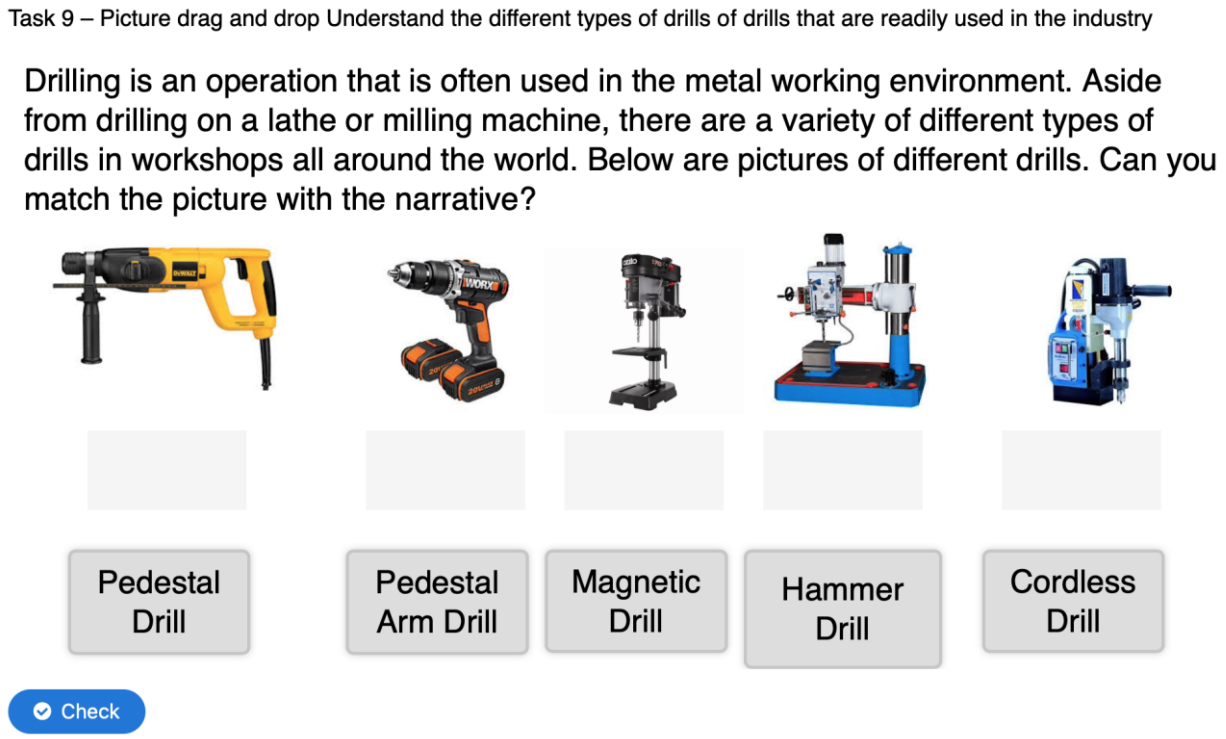

Figure 35: Interactive exercise
Source: EDU-VET LEARNING PLATFORM (2021).

References

EDU-VET LEARNING PLATFORM (2021): The EDU-VET Learning Platform. http://edu-vet.eduproject.eu. Erasmus+ Project EDU-VET: E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry. Paderborn 2020.

Part C – Teaching and Learning Materials

9. The EDU-VET learning modules

CIFP Someso / Graafschap College / Lancaster and Morecamb College

9.1 Module 1: Entry Drilling

This chapter will give you an insight into the first learning module within the EDUVET project. Throughout this chapter we will look at the learning outcomes needed to be achieved and the format of what the e-learning looks like!

When you first log into the EDUVET Moodle platform, you will see courses to choose from. This image indicates how you would access this learning module – for this instance entry level drilling. You are then directed to the page where the content and learning activities are based.

Figure 36: EDU-VET Learning Module 1
Source: EDU-VET LEARNING PLATFORM (2021).

All EDUVET learning modules are started with a brief introduction. The introduction welcomes you to the learning module and contains a brief introduction on what to expect for the module selected.

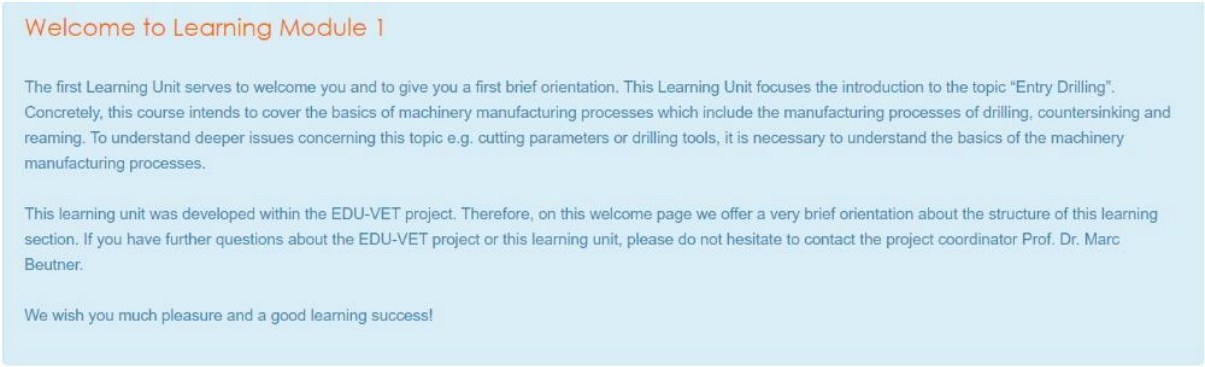

Figure 37: EDU-VET Learning Module 1 – Welcome
Source: EDU-VET LEARNING PLATFORM (2021).

Each learning module has been structured so that the learning objectives are clear and precise.

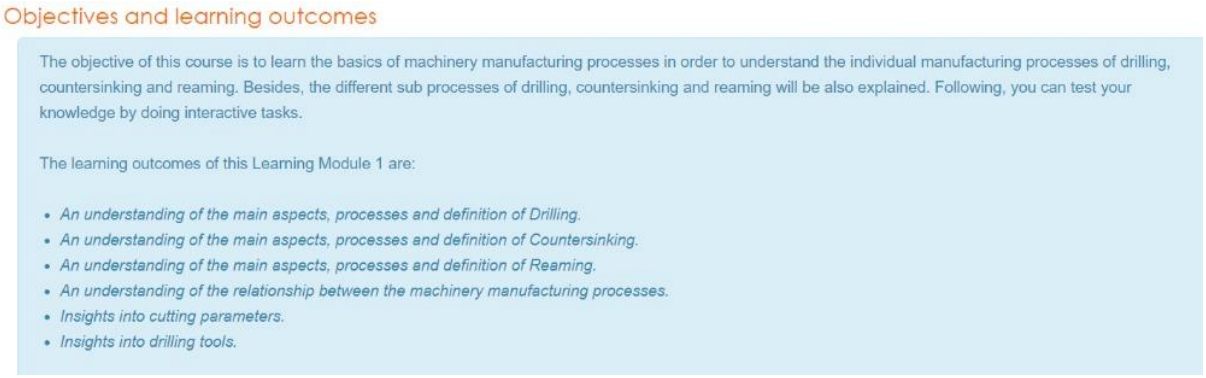

Figure 38: EDU-VET Learning Module 1 – Objectives and learning outcomes
Source: EDU-VET LEARNING PLATFORM (2021).

These outcomes are achieved by the learner logging onto the online course and working their way through the learning units and familiarising themselves with the additional learning materials and tasks.

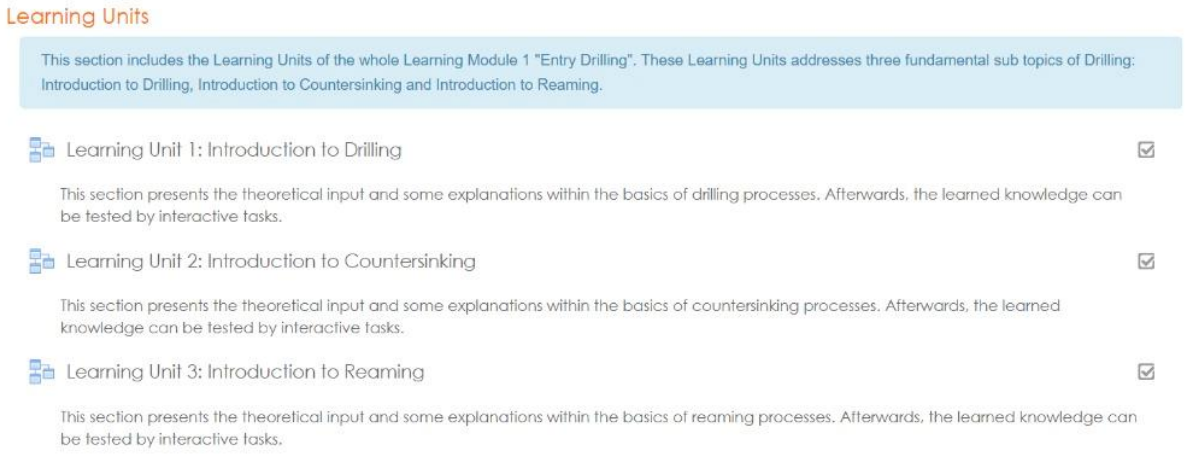

Figure 39: EDU-VET Learning Module 1 – Learning Units
Source: EDU-VET LEARNING PLATFORM (2021).

The additional material and tasks contain tasks which integrate all topics from the learning units. It is a chance to test your knowledge and see what you have learnt.

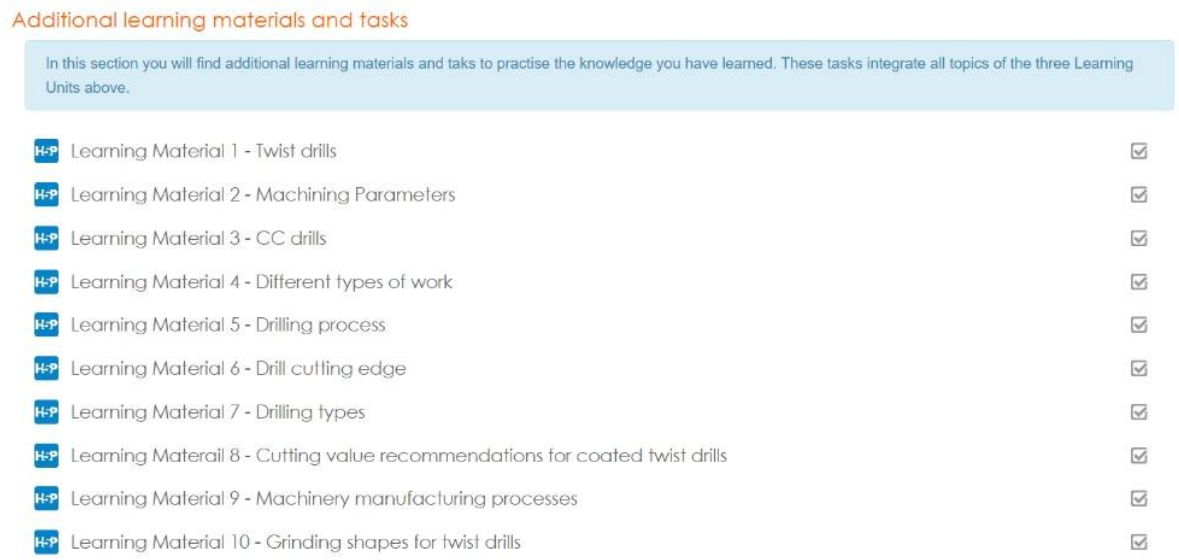

Figure 40: EDU-VET Learning Module 1 – Additional learning materials and tasks
Source: EDU-VET LEARNING PLATFORM (2021).

To finalise, the online learning course has both a glossary of terms and a chat function. Here learners can participate in forums and ask questions which will be directly answered by a teacher once they have logged in.

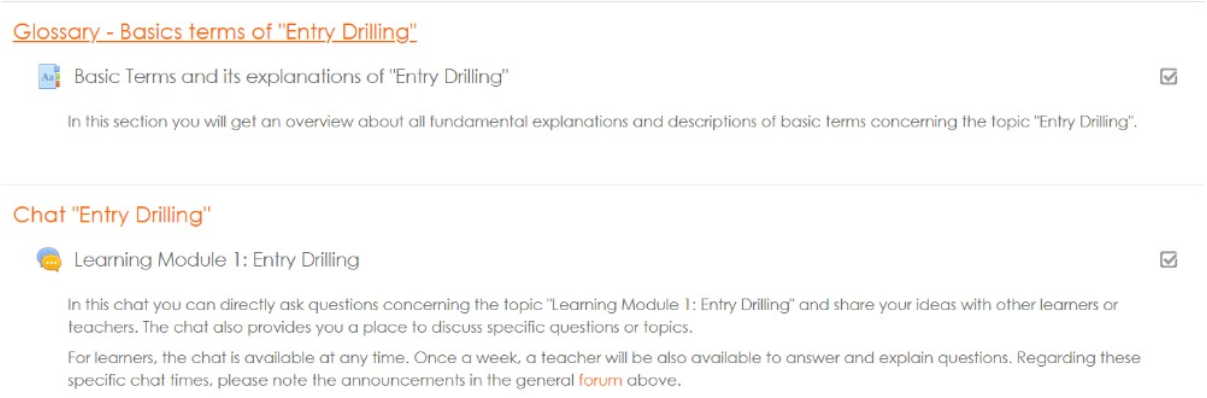

Figure 41: EDU-VET Learning Module 1 – Glossary and Chat
Source: EDU-VET LEARNING PLATFORM (2021).

When learners enrol on the e-learning platform, there are 3 levels that the resources and learning outcomes are aimed at. Entry level is aimed at those in the 12-14 year old age group. Introductory is aimed at those in the 14-16 year age group and the advance level is aimed at those in the 16-18 year old age group.

We expect learners who are attempting the entry level courses to gain a basic understanding of the drilling process and must bear in mind learners may not have any prior experience in the

operations of drills and the different types of drill that are readily used in an engineering environment

This is shown by the level of task. As the level of learning increases then so does the complexity of the learning units and the additional tasks. As the learner progresses through the levels, the knowledge that they have gained during previous modules is put to the test.

Entry drilling has 3 learning units. At the end of each learning unit your knowledge will be tested with a variety of tasks.

9.1.1 Learning unit 1 – Introduction to drilling

This unit starts by you gathering some basic knowledge. You learn the definitions of 3 key aspects – Machinery manufacturing processes, the drilling process and cutting parameters. It is important that the definitions are understood as it is likely learners will never have either operated a lathe or have the basic skills required to operate one. After spending some time understanding these definitions, your knowledge is put into practice by answering one or two relatively easy questions.

An example of a definition is pictured below:

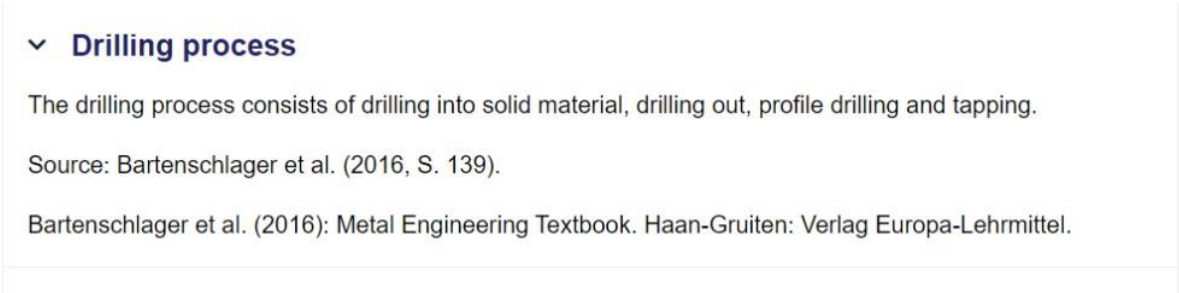

Figure 42: EDU-VET Learning Module 1 – Learning Unit: Drilling process
Source: EDU-VET LEARNING PLATFORM (2021).

9.1.2 Learning unit 2 – Introduction to countersinking

Learning unit 2 starts with a definition of the countersinking process and how it can be achieved. Once the learner has understood the definition, the learner is directed to a visual page where the countersinking tool is displayed. The learner is then provided with more knowledge on the core elements of countersinking. Again, this unit is then tested at the end with a basic question where the learner is asked to explain the countersinking process in their own words.

9.1.3 Learning unit 3 – Introduction to Reaming

Here the learner gains some vital information on the process that is reaming. The learner is tasked with understanding the difference between the processes. The definition contains some key information which needs to be learnt. The information learnt is then tested by attempting the additional learning tasks.

Additional e-learning tasks:

There are a variety of additional H5P tasks and learning resources that have been created for this module. The first task is a drag and drop exercise when asks the learner to differentiate between grinding errors of twist drills and grinding shapes of twist drills. Here the learner must drag the correct narrative to the section they believe it belongs. At the end of the task you can check to see if your answers were correct or not. A score is also indicated to inform you of your progress, as seen below:

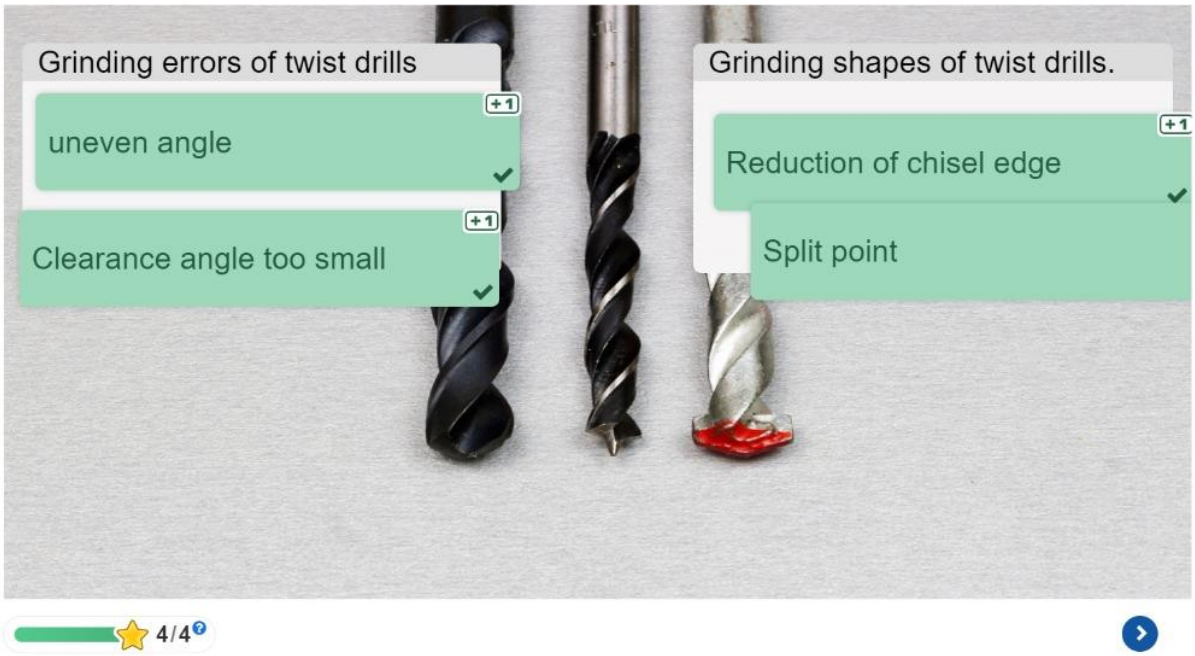

Figure 43: EDU-VET Learning Module 1 – Additional tasks
Source: EDU-VET LEARNING PLATFORM (2021).

There is a total of 10 additional learning materials for entry level drilling. These include:

Dialog cards – The student is given a picture of a milling machine with the narrative “cutting speed”, once they turn the card around a definition and description of cutting speed can be found

Multiple choice questions – A basic question will be asked and the student has four potential answers, only the correct one allows the learner to progress

Pairs – A serious of pictures are shown so that you only see the question marks. By turning over the card, you see the picture and must match it with a corresponding picture. The attempts are timed.

Visual aids and definitions are also used to provide some additional learning.

9.2 Module 2: Entry Turning

9.2.1 Insight into content and structure of Module 2

This learning unit has been designed as a first step into the topic of Turning. The basic concepts about this topic are introduced here, covering the basics of this machine tool and its manufacturing processes. In fact, this learning unit has been designed to develop and make easier a deeper understanding of advanced aspects of the topic that will be explained in next learning units.

This module is made of several parts:

- The welcome to the Learning Module which is just a paragraph to welcome you to the module.
- Five learning units. Where the user can find contents; including explanations, images, diagrams, interactive activities and even videos; so as to get a deep knowledge of each specific topic.
- The additional learning materials. Which consist of 17 interactive activities to be performed by the users, once they have checked the corresponding learning unit, so as to reinforce the acquired knowledge.
- The glossary. Where an overview about all fundamental explanations and descriptions of basic terms concerning the topic "Entry Turning" is presented.
- The chat which is intended to ask questions concerning the topic of the module and share ideas with other learners or teachers.

To start with the learning process, the users must access each learning unit in order (1, 2, 3… n). Once a learning unit has been checked, they should go to the additional learning materials (check the section of “Organization of the activities”) and complete the activities included.

In case of difficulties, they can use the glossary that can help them to solve doubts. The chats, where other classmates or the teachers can help them with whatever they need, are also available.

The users should study each learning unit and its associated activities in order, starting with the first and ending with the fifth.

9.2.2 Online materials

The main material types within this course are Learning Units and Additional Materials.

- *Learning Units*

  It must be taken into account that, within each learning unit, images, diagrams, interactive activities and even videos are included. Some examples are shown below.

  - *EDU-VET-EN-Turning-01-Basic Contents*

    This section presents an initial introduction to the metal engineering world, specifically in regards to lathe turning.

    It includes a brief introduction to drawing, material technology and metrology.

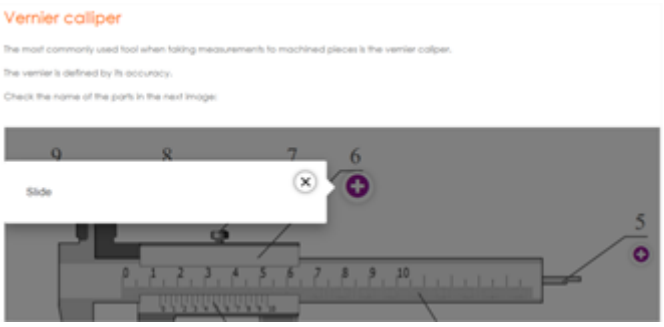

Figure 44: EDU-VET Learning Module 1 – Learning Unit: Task 1
Source: EDU-VET LEARNING PLATFORM (2021).

  - *EDU-VET-EN-Turning-02-Turning Lathe*

    A turning lathe is a machine that shapes the pieces of revolution by chip removal.

    This section is intended to give the basic information to get a first knowledge about the turning lathes: types, parts, working conditions and safety requirements.

Figure 45: EDU-VET Learning Module 1 – Learning Unit: Task 2
Source: EDU-VET LEARNING PLATFORM (2021).

- *EDU-VET-EN-Turning-03-Turning tools and clamping systems*

  In order to perform different turning operations, different tools will be required.

  In this unit we look at the different tools and clamping systems available.

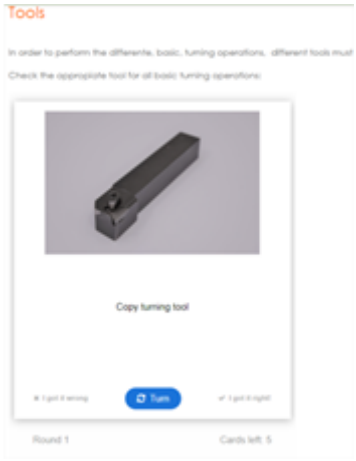

Figure 46: EDU-VET Learning Module 1 – Learning Unit: Task 3
Source: EDU-VET LEARNING PLATFORM (2021).

- *EDU-VET-EN-Turning-04-Working plan*

  For the optimal production of mechanical parts is not only about machining but also organizing and verifying.

  In this unit some documentation to organize machining operation and results verification will be presented.

- *Timeline for machining a workpiece*

  That is an introduction to the next learning unit (EDU-VET-EN-Turning-05-Turning operations)

- *EDU-VET-EN-Turning-05-Turning operations*

  Usually, in order to obtain a finished piece, it will be required to perform different operations. In this unit we present the most common ones.

- *Additional learning materials*

  The additional learning materials consist, mainly, in interactive activities to be perform by the students , once he has check the corresponding learning unit, so as to reinforce the acquired knowledge.

  All these learning materials are listed below:

  Activity 1. Materials.

  Activity 1. Vernier measurement 1.

  Activity 1. Vernier measurement 2.

  Activity 1. Vernier measurement 3.

  Activity 1. Venier uses.

  Activity 2. Lathe parts.

  Activity 2.

  Activity 3. Tools and clamping systems.

  Activity 4.Operations.

  Activity 4. Filling a working sheet (entry level).

  Activity 4. Filling a control sheet (entry level).

  Activity 5. Machining.

  Activity 5. Operation-Tool 1.

  Activity 5. Operation-Tool 2.

Activity-Workshop. Machining workpiece 1.

Activity-Workshop. Machining workpiece 2.

Activity-Workshop. Machining workpiece 3.

- *Organisation of the activities*

Each of them is related to a specific learning unit. The number on the name of the activity stands for the learning unit at which it belongs. Check the next table:

Activity	LU	Activity type
Activity 1. Materials	1	Drag and drop
Activity 1. Vernier measurement 1	1	Fill in the blanks
Activity 1. Vernier measurement 2	1	Fill in the blanks
Activity 1. Vernier measurement 3	1	Fill in the blanks
Activity 1. Venier uses	1	Simple match questions
Activity 2. Lathe parts	2	Missing words
Activity 2	2	Simple choice test Fill in the blanks
Activity 3. Tools and clamping systems	3	True and false questions Fill in the blanks Simple choice test
Activity 4.Operations	4	Image sequencing
Activity 4. Filling a working sheet (entry level)	4	Complete a working sheet by hand writing
Activity 4. Filling a control sheet (entry level)	4	Complete a control sheet by hand writing
Activity 5. Machining	5	Image sequencing
Activity 5. Operation-Tool 1	5	Image pairing
Activity 5. Operation-Tool 2	5	Find the words
Activity-Workshop. Machining workpiece 1	5	Machine a real piece in the workshop

Activity-Workshop. Machining workpiece 2	5	Machine a real piece in the workshop
Activity-Workshop. Machining workpiece 3	5	Machine a real piece in the workshop

Figure 47: Organisation of the activities 1
Source: Own representation.

9.2.3 Classroom materials

The training approach for the implementation of the EDU-VET platform is blended learning, i.e. a section of the training program associated with this module is available online for the student; therefore he will be able to develop his learning process autonomously, while another section takes place in person in the workshops of the VET institution.

By taking both sections, the student will be able to achieve the professional competencies foreseen in each of the training modules included within the EDU-VET platform.

In the case of the workshop, the activities to be carried out by the student will be purely practical, i.e. only the execution of practical work on the machine tool that is the object of this module, the lathe, is foreseen. These activities have already been previously posted on the EDU-VET platform and have been studied by the student. In this way, the circle is closed, workshop time is optimized and full learning is achieved by the student.

The materials used in this part of the workshop are:

- Computer
- Internet connection
- Technical documentation as drawings, work sheets, etc.
- Raw material
- Lathe and its tools.
- Measurement devices as vernier caliper, micrometer, thread comb, etc.

9.3 Module 3: Entry Milling

9.3.1 Insight into content and structure of Module 3

This learning unit has been designed as a first step into the topic of Milling. The basic concepts about this topic are introduced here, covering the basics of this machine tool and its manufacturing processes. In fact, this learning unit has been designed to develop and make easier a deeper understanding of advanced aspects of the topic that will be explained in next learning units.

This module is made of several parts:

The welcome to the Learning Module which is just a paragraph to welcome you to the module. Four learning units. Where the user can find contents.

The additional learning materials. Which consist of 5 interactive activities to be performed by the users, once they have checked the corresponding learning unit, so as to reinforce the acquired knowledge.

The glossary. Where an overview about all fundamental explanations and descriptions of basic terms concerning the topic "Entry Turning" is presented.

The chat which is intended to ask questions concerning the topic of the module and share ideas with other learners or teachers.

To start with the learning process, the users must access each learning unit in order (1, 2, 3… n). Once a learning unit has been checked, they should go to the additional learning materials (check the section of “Organization of the activities”) and complete the activities included.

In case of difficulties, they can use the glossary that can help them to solve doubts. The chats, where other classmates or the teachers can help them with whatever they need, are also available.

The users should study each learning unit and its associated activities in order, starting with the first and ending with the fifth.

9.3.2 Online materials

The main material types within this course are Learning Units and Additional Materials.

Learning Units

It must be taken into account that, within each learning unit, images, diagrams, interactive activities and even videos are included. Some examples are shown below.

EDU-VET-EN-Milling explanation

This section presents an initial introduction to the metal engineering world, specifically in regards to milling.

It includes a brief introduction to drawing, material technology and metrology.

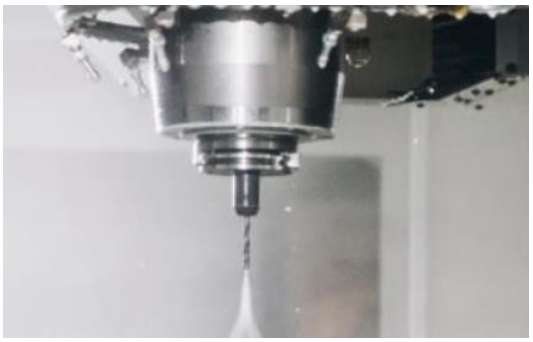

Figure 48: EDU-VET-EN-Milling machines various types
Source: EDU-VET LEARNING PLATFORM (2021).

Nowadays we find several types of milling machines. The most are universal and CNC machines.

In the past there were simple horizontal and vertical milling machines. With a Universal machine you can do both of these processes. The milling machine has to be converted to the desired milling process.

Figure 49: EDU-VET-EN-Turning-03-Movements in milling
Source: EDU-VET LEARNING PLATFORM (2021).

The milling machine has various movements. Of course you can move the bed in the directions X, Y and Z. These movements you can do by hand.

Milling is a process of creating chips.

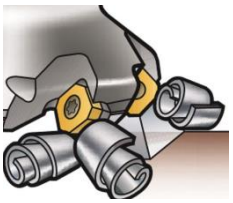

Figure 50: EDU-VET-EN-Turning-04-Proces of milling
Source: EDU-VET LEARNING PLATFORM (2021).

Additional learning materials

The additional learning materials consist, mainly, in interactive activities to be perform by the students, once he has checked the corresponding learning unit, so as to reinforce the acquired knowledge.

All these learning materials are listed below:

Activity 1. Milling machine 1

Activity 2. Milling machine 2

Activity 3. V-D Diagram

Activity 4. Calculating the speed

Activity 5. Calculating feedrate

Organisation of the activities

Each of them is related to a specific learning unit. The number on the name of the activity stands for the learning unit at which it belongs. Check the next table:

Activity	LU	Activity type
Activity 1. Milling machine 1	1	Image hotspots
Activity 2. Milling machine 2	2	Find the words
Activity 3. V-D Diagram	3	Fill in the blanks
Activity 4. Calculating the speed	4	True/False Question
Activity 5. Calculating feedrate	5	Fill in the blanks

Figure 51: Organisation of the activities 2
Source: Own representation.

9.3.3 Classroom materials

The training approach for the implementation of the EDU-VET platform is blended learning, i.e. a section of the training program associated with this module is available online for the student; therefore he will be able to develop his learning process autonomously, while another section takes place in person in the workshops of the VET institution.

By taking both sections, the student will be able to achieve the professional competencies foreseen in each of the training modules included within the EDU-VET platform.

In the case of the workshop, the activities to be carried out by the student will be purely practical, i.e. only the execution of practical work on the machine tool that is the object of this module, the lathe, is foreseen. These activities have already been previously posted on the EDU-VET platform and have been studied by the student. In this way, the circle is closed, workshop time is optimized and full learning is achieved by the student.

The materials used in this part of the workshop are:

- Computer
- Internet connection
- Technical documentation as drawings, work sheets, etc.
- Raw material
- Milling machine and its tools
- Measurement devices as vernier caliper, micrometer, thread comb, etc.

9.4 Module 4: Advanced Drilling / Turning

This chapter focuses on Advance drilling and turning within the EDUVET project learning modules. This is module 4. Here, the knowledge and skills that have been gained through previous content and chapters, and expanded on and put to the test. The advanced drilling and turning modules are a rise in complexity compared to previous modules.

Like previous and existing chapters within this platform, Advanced drilling and turning begins with an introduction:

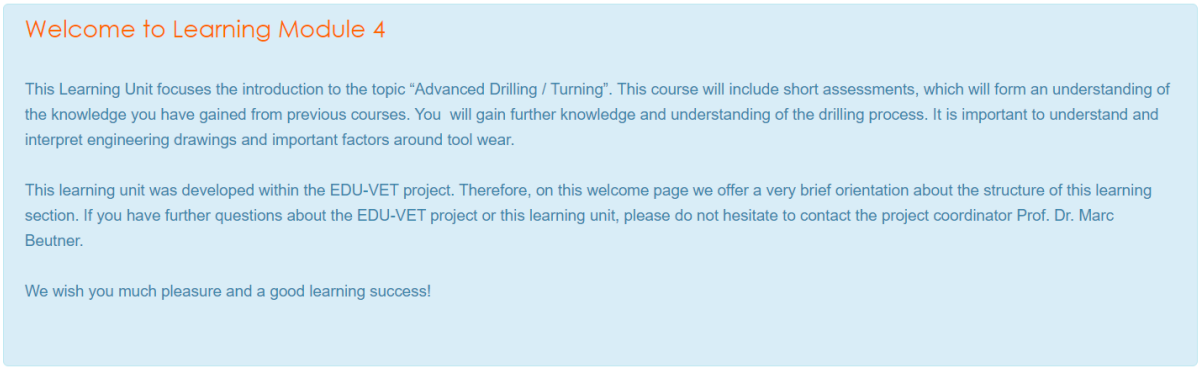

Figure 52: EDU-VET Learning Module 4 –Welcome
Source: EDU-VET Learning Platform (2021).

The structure of the chapter is like other chapters, in that we see the learning outcomes and objectives to follow, followed by the learning units. The learning units for this module are:

- Cutting Parameters of drilling process
- Twist drill types

- Engineering Drawings

Once the learning units have been followed and understood, there are some additional learning tasks, which take into consideration content you have already studied and test that newly found knowledge in the form of various H5P tasks.

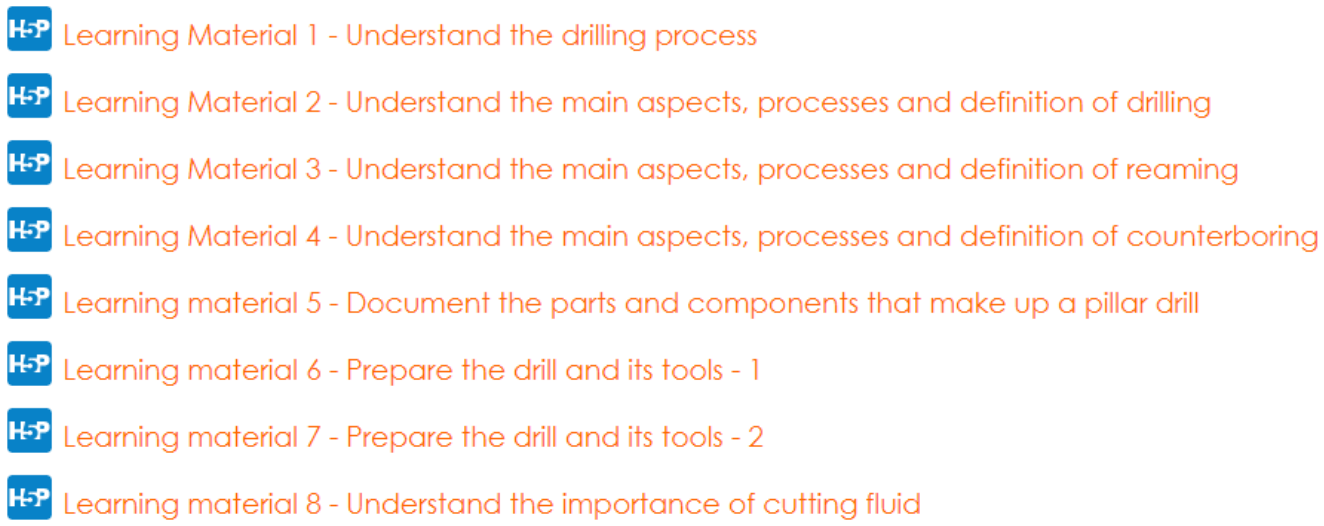

Figure 53: EDU-VET Learning Module 4 –H5P tasks
Source: EDU-VET LEARNING PLATFORM (2021).

Finally, like other modules, there is a chat and forum function along with a glossary of terms.

9.5 Module 5: Advanced Drilling / Milling

9.5.1 Insight into content and structure of Module 5

This learning unit has been designed as a first step into the topic of Milling. The basic concepts about this topic are introduced here, covering the basics of this machine tool and its manufacturing processes. In fact, this learning unit has been designed to develop and make easier a deeper understanding of advanced aspects of the topic that will be explained in next learning units.

This module is made of several parts:

The welcome to the Learning Module which is just a paragraph to welcome you to the module.

Three learning units. Where the user can find contents; including explanations, images, diagrams, interactive activities and even videos; so as to get a deep knowledge of each specific topic.

The additional learning materials. Which consist of six interactive activities to be performed by the users, once they have checked the corresponding learning unit, so as to reinforce the acquired knowledge.

The glossary. Where an overview about all fundamental explanations and descriptions of basic terms concerning the topic "Advanced Drilling / milling" is presented.

The chat which is intended to ask questions concerning the topic of the module and share ideas with other learners or teachers.

To start with the learning process, the users must access each learning unit in order (1, 2, 3… n). Once a learning unit has been checked, they should go to the additional learning materials (check the section of "Organization of the activities") and complete the activities included.

In case of difficulties, they can use the glossary that can help them to solve doubts. The chats, where other classmates or the teachers can help them with whatever they need, are also available.

The users should study each learning unit and its associated activities in order, starting with the first and ending with the fifth.

9.5.2 Online materials

The main material types within this course are Learning Units and Additional Materials.

Learning Units

It must be taken into account that, within each learning unit, images, diagrams, interactive activities and even videos are included. Some examples are shown below.

EDU-VET-EN-Cutting parameters

This section focuses on the understanding of cutting parameters of milling process. Afterwards, the learned knowledge can be tested by interactive tasks.

$$N = \frac{Vx1000}{\pi xD}$$

With:

- V = cutting speed in m/min;
- D = cutter diameter in mm;
- N = rotational speed in rpm.

Figure 54: EDU-VET-EN-Cutting parameters
Source: EDU-VET LEARNING PLATFORM (2021).

EDU-VET-EN-Turning-02-Cutter types

This section focuses on cutter types:

Figure 55: EDU-VET-EN-Turning-02-Cutter types
Source: EDU-VET LEARNING PLATFORM (2021).

EDU-VET-EN-Turning-03- Dimensions in the engineering drawings

This part focuses on reading and understanding dimension marking in technical drawings.

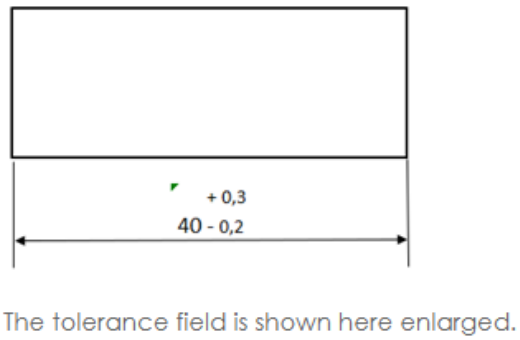

Figure 56: EDU-VET-EN-Turning-03- Dimensions in the engineering drawings
Source: EDU-VET LEARNING PLATFORM (2021).

Additional learning materials

The additional learning materials consist, mainly, in interactive activities to be perform by the students , once he has check the corresponding learning unit, so as to reinforce the acquired knowledge.

Activity 1. Understand the milling process
Activity 2. Understand the milling types
Activity 3. Cutter types 1
Activity 4. Cutter types 2
Activity 5. Dimensions 1
Activity 6. Dimensions 2

Organisation of the activities

Each of them is related to a specific learning unit. The number on the name of the activity stands for the learning unit at which it belongs. Check the next table:

Activity	LU	Activity type
Activity1. Calculate the cutting speed	1	Multiple choice
Activity1. cutting speed	1	Drag the words
Activity1. cutting speed	1	True/false question
Activity1. Feed	1	Multiple choice
Activity.1 Spindle speed	1	True/false question
Activity2. Cutter types	2	Multiple choice
Activity2. Material types	2	Multiple choice
Activity2. Number of teeth	2	Fill in the blanks
Activity2. Face mill	2	True/false question
Activity2. End mill	2	True/false question
Activity3. Finding the cutter types	2	Find the words
Activity4. Find the image	2	Memory game
Activity5. Dimensions 1	3	Multiple choice
Activity6. Dimensions 2	3	Multiple choice

Figure 57: Organisation of the activities 3
Source: Own representation.

9.5.3 Classroom materials

The training approach for the implementation of the EDU-VET platform is blended learning, i.e. a section of the training program associated with this module is available online for the student; therefore he will be able to develop his learning process autonomously, while another section takes place in person in the workshops of the VET institution.

By taking both sections, the student will be able to achieve the professional competencies foreseen in each of the training modules included within the EDU-VET platform.

In the case of the workshop, the activities to be carried out by the student will be purely practical, i.e. only the execution of practical work on the machine tool that is the object of this module, the lathe, is foreseen. These activities have already been previously posted on the EDU-

VET platform and have been studied by the student. In this way, the circle is closed, workshop time is optimized and full learning is achieved by the student.

The materials used in this part of the workshop are:

- Computer
- Internet connection
- Technical documentation as drawings, work sheets, etc.
- Raw material
- Lathe and its tools.
- Measurement devices as vernier caliper, micrometer, thread comb, etc.

9.6 Module 6: Advanced Turning / Drilling

9.6.1 Insight into content and structure of Module 6

This learning unit has been designed as a first step into the topic of Turning. The basic concepts about this topic are introduced here, covering the basics of this machine tool and its manufacturing processes. In fact, this learning unit has been designed to develop and make easier a deeper understanding of advanced aspects of the topic that will be explained in next learning units.

This module is made of several parts:

- The welcome to the Learning Module which is just a paragraph to welcome you to the module.
- Five learning units. Where the user can find contents; including explanations, images, diagrams, interactive activities and even videos; so as to get a deep knowledge of each specific topic.
- The additional learning materials. Which consist of 19 interactive activities to be performed by the users, once they have checked the corresponding learning unit, so as to reinforce the acquired knowledge.
- The glossary. Where an overview about all fundamental explanations and descriptions of basic terms concerning the topic "Advanced turning / milling" is presented.
- The chat which is intended to ask questions concerning the topic of the module and share ideas with other learners or teachers.

To start with the learning process, the users must access each learning unit in order (1, 2, 3… n). Once a learning unit has been checked, they should go to the additional learning materials (check the section of "Organization of the activities") and complete the activities included.

In case of difficulties, they can use the glossary that can help them to solve doubts. The chats, where other classmates or the teachers can help them with whatever they need, are also available.

The users should study each learning unit and its associated activities in order, starting with the first and ending with the fifth.

9.6.2 Online materials

The main material types within this course are Learning Units and Additional Materials.

- *Learning Units*

  It must be taken into account that, within each learning unit, images, diagrams, interactive activities and even videos are included. Some examples are shown below.

  - EDU-VET-EN-Turning-01-Basic Contents

    This section presents an initial introduction to the metal engineering world, specifically in regards to lathe turning.

It includes a brief introduction to material technology and metrology.

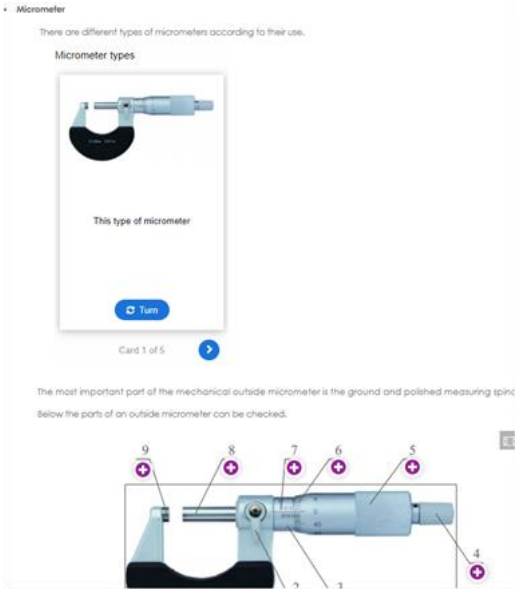

Figure 58: EDU-VET-EN-Turning-01-Basic Contents
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-02-Turning tools, catalogues

  A turning lathe is a machine that shapes the work-pieces of revolution by chip removal.

  This section is intended to give the basic information to get a first knowledge about the turning lathes: types, parts, working conditions and safety requirements.

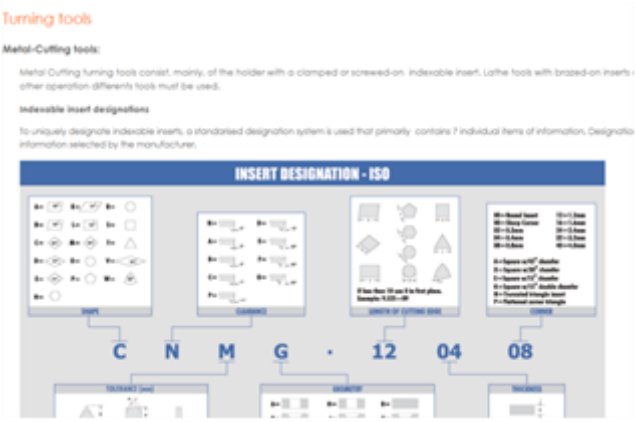

Figure 59: EDU-VET-EN-Turning-02-Turning tools, catalogues
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-03-Computations for different turning operations

  In order to perform different turning operations, the computation of different parameters will be required.

  In this unit we check some of those computations.

- EDU-VET-EN-Turning-04-Working plan

  For the optimal production of mechanical parts is not only about machining but also organizing and verifying.

  In this unit some documentation to organize machining operation and results verification will be presented.

- EDU-VET-EN-Turning-05- Performance of turning operations

  Usually, in order to obtain a finished piece, it will be required to perform different operations. In this unit we present the most common ones.

Additional learning materials

The additional learning materials consist, mainly, in interactive activities to be perform by the students , once he has check the corresponding learning unit, so as to reinforce the acquired knowledge.

- Activity 1. Ferrous & Non Ferrous Metals.
- Activity 1. Micrometer -1.
- Activity 1. Micrometer -2.
- Activity 1. Micrometer -3.
- Activity 1 Dial-gauge -1.
- Activity 1. Dial-gauge -2.
- Activity 2. Tools designation 1.
- Activity 2. Tools designation 2.
- Activity 2. Catalogue.
- Activity 3.Computing working conditions.
- Activity 3.Threading.
- Activity 3. Rate of taper.
- Activity 4. Filling an instructions sheet.
- Activity 4. Filling a working sheet.
- Activity 5. Threading 1.
- Activity 5. Threading 2.
- Activity-Workshop. Machining workpiece 1.
- Activity-Workshop. Machining workpiece 2.
- Activity-Workshop. Machining workpiece 3.

Organisation of the activities

Each of them is related to a specific learning unit. The number on the name of the activity stands for the learning unit at which it belongs. Check the next table:

Activity	LU	Activity type
Activity1. Ferrous & Non Ferrous Metals	1	Drag and drop
Activity1. Micrometer -1	1	Fill in the blanks
Activity1. Micrometer -2	1	Fill in the blanks
Activity1. Micrometer -3	1	Fill in the blanks
Activity.1 Dial-gauge -1	1	Fill in the blanks
Activity1. Dial-gauge -2	1	Fill in the blanks
Activity2. Tools designation 1	2	Drag and drop
Activity2. Tools designation 2	2	Drag and drop
Activity2. Catalogue	2	Fill in the blanks Multiple choice test
Activity3.Computing working conditions	3	True or false questions
Activity3.Threading	3	Simple choice test
Activity3. Rate of taper	3	Simple choice test
Activity4. Filling an instructions sheet	4	Complete an instructions sheet by hand writing
Activity4. Filling a working sheet	4	Complete a working sheet by hand writing
Activity5. Threading 1	5	Fill in the blanks
Activity5. Threading 2	5	Fill in the blanks
Activity-Workshop. Machining workpiece 1	5	Machine a real piece in the workshop
Activity-Workshop. Machining workpiece 2	5	Machine a real piece in the workshop

Figure 60: Organisation of the activities 4
Source: Own representation.

9.6.3 Classroom materials

The training approach for the implementation of the EDU-VET platform is blended learning, i.e. a section of the training program associated with this module is available online for the student; therefore he will be able to develop his learning process autonomously, while another section takes place in person in the workshops of the VET institution.

By taking both sections, the student will be able to achieve the professional competencies foreseen in each of the training modules included within the EDU-VET platform.

In the case of the workshop, the activities to be carried out by the student will be purely practical, i.e. only the execution of practical work on the machine tool that is the object of this module, the lathe, is foreseen. These activities have already been previously posted on the EDU-VET platform and have been studied by the student. In this way, the circle is closed, workshop time is optimized and full learning is achieved by the student.

The materials used in this part of the workshop are:

- Computer
- Internet connection
- Technical documentation as drawings, work sheets, etc.
- Raw material
- Lathe and its tools.
- Measurement devices as vernier caliper, micrometer, thread comb, etc.

9.7 Module 7: Experienced Drilling / Turning / Milling 1

This chapter focuses on experienced drilling, turning, and milling within the EDUVET project learning modules. This is module 7. At an experienced level, the learner is given much more detailed and complex tasks to complete. The learner uses the vital fundamental skills and knowledge that have been gained through previous modules and more relevant processes such as calculations are explored. Again, like previous chapters an introduction is first shown:

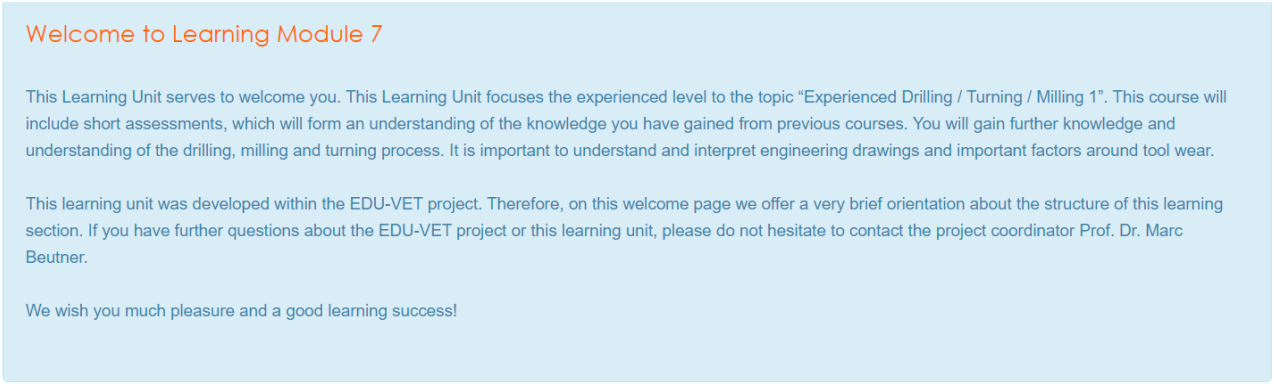

Figure 61: EDU-VET Learning Module 7 –Welcome
Source: EDU-VET LEARNING PLATFORM (2021).

The learning objectives and outcomes for this module can be seen below:

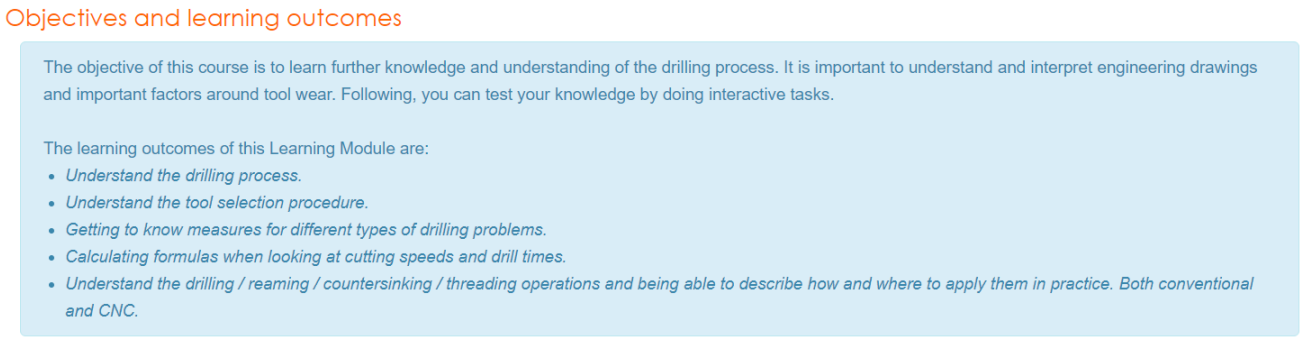

Figure 62: EDU-VET Learning Module 7 –Objectives and learning outcomes
Source: EDU-VET LEARNING PLATFORM (2021).

The structure of the remainder of the chapter follows previous learning modules. We have a chat and forum function and a glossary of terms. Again, there are learning units built into this module. These are:

- Understand the tool selection procedure
- Measures for drilling problems
- Cutting speed and drill times

These can be tested further by completing the additional H5P learning materials, as shown below:

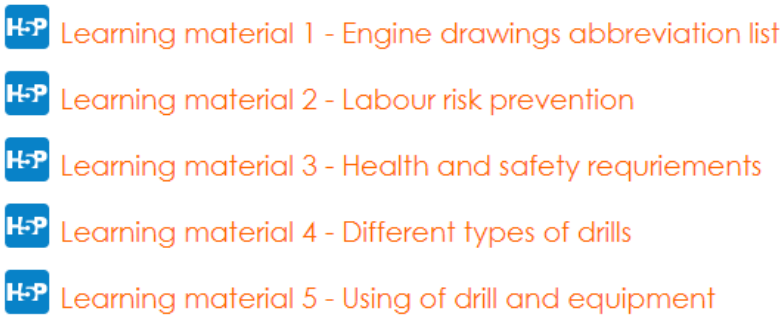

Figure 63: EDU-VET Learning Module 7 – H5P tasks
Source: EDU-VET LEARNING PLATFORM (2021).

9.8 Module 8: Experienced Drilling / Turning / Milling 2

9.8.1 Insight into content and structure of Module 8

This learning unit has been designed as a first step into the topic of CNC Turning. The basic concepts about this topic are introduced here, covering the basics of this machine tool and its manufacturing processes. In fact, this learning unit has been designed to develop and make easier a deeper understanding of advanced aspects of the topic that will be explained in next learning units.

This module is made of several parts:

- The welcome to the Learning Module which is just a paragraph to welcome you to the module.
- Eight learning units. Where the user can find contents; including explanations, images, diagrams, interactive activities and even videos; so as to get a deep knowledge of each specific topic.
- The additional learning materials. Which consist of 10 interactive activities to be performed by the user, once they have checked the corresponding learning unit, so as to reinforce the acquired knowledge.
- The glossary. Where an overview about all fundamental explanations and descriptions of basic terms concerning the topic "Experienced drilling / turning / milling 2" is presented.
- The chat which is intended to ask questions concerning the topic of the module and share ideas with other learners or teachers.

To start with the learning process, the users must access each learning unit in order (1, 2, 3… n). Once a learning unit has been checked, they should go to the additional learning materials (check the section of “Organization of the activities”) and complete the activities included.

In case of difficulties, they can use the glossary that can help them to solve doubts. The chats, where other classmates or the teachers can help them with whatever they need, are also available.

The users should study each learning unit and its associated activities in order, starting with the first and ending with the fifth.

9.8.2 Online materials

The main material types within this course are Learning Units and Additional Materials.

Learning Units

It must be taken into account that, within each learning unit, images, diagrams, interactive activities and even videos are included. Some examples are shown below.

- EDU-VET-EN-Turning-01- Basic Contents

  This section presents an initial contact with the Numeric Control programming. It includes a brief introduction to the coordinate systems, so it will help us to get started in the course of lathe turning in CNC machines.

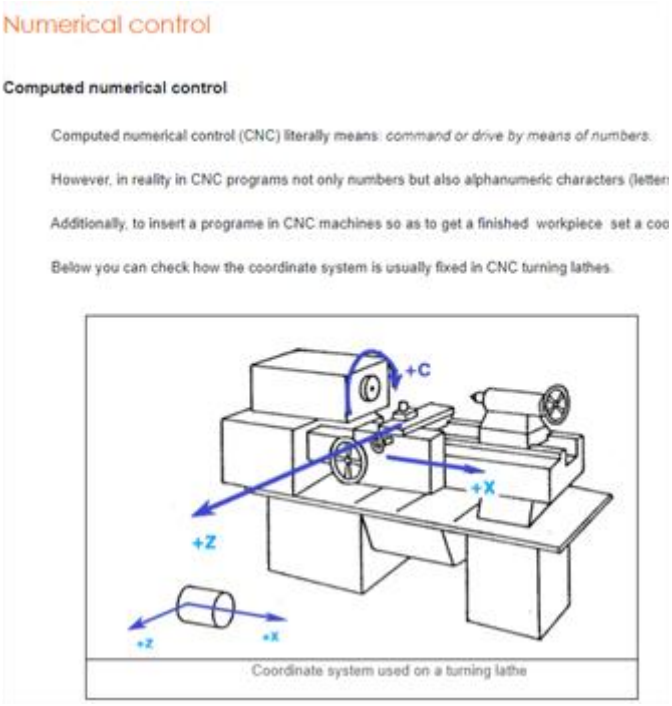

Figure 64: EDU-VET-EN-Turning-01- Basic Contents
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-02- Basic Movements in CNC machines

  This section presents an initial contact with programming.

  It includes a brief description of a regular program parts, and how start programming.

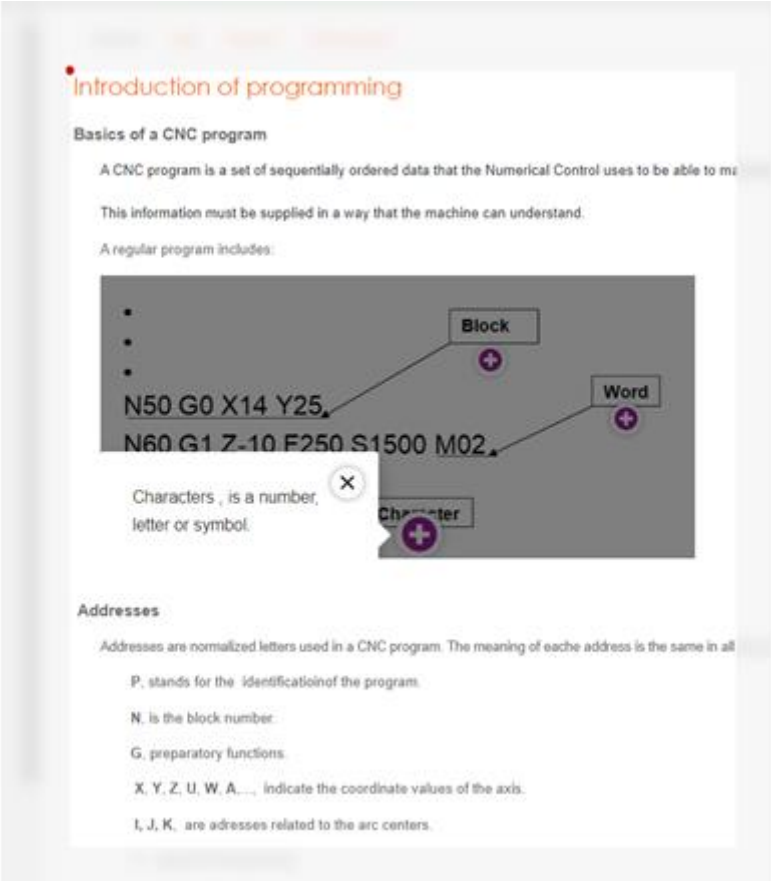

Figure 65: EDU-VET-EN-Turning-02- Basic Movements in CNC machines
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-03- Cylindrical and Face turning in CNC lathes

  In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and perform cylindrical and face turning are presented.

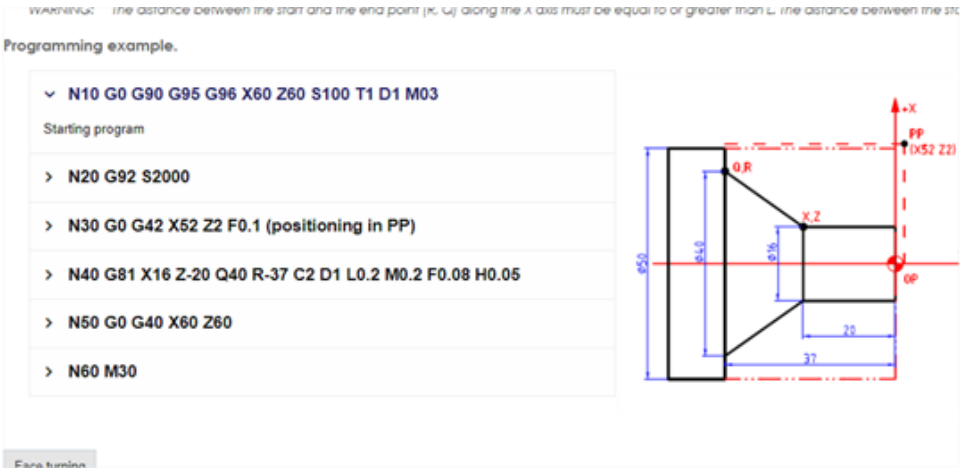

Figure 66: EDU-VET-EN-Turning-03- Cylindrical and Face turning in CNC lathes
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-04-Axial drilling and tapping canned cycle

  In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and drill a piece are presented.

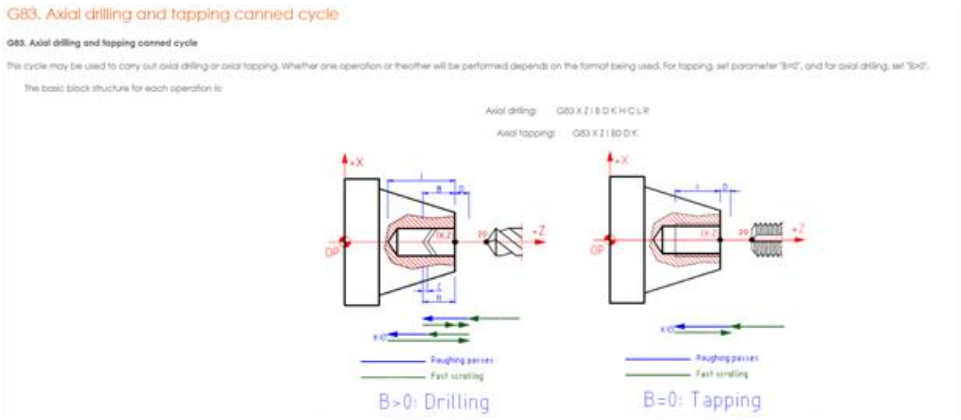

Figure 67: EDU-VET-EN-Turning-04-Axial drilling and tapping canned cycle
Source: EDU-VET LEARNING PLATFORM (2021).

- EDU-VET-EN-Turning-05- Cylindrical and Face turning in CNC lathes (rounded)

  In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and perform the cylindrical and face rounded turning are presented.

- EDU-VET-EN-Turning-06. Stock removal cycle along X and Z axis.

  In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and perform the stock removal along x and z axis are presented.

- EDU-VET-EN-Turning-07. X axis grooving (G88) and Z axis grooving (G89) canned cycle.

  In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and machine groves are presented.

- EDU-VET-EN-Turning-08. Longitudinal threading and G87 face threading canned cycle

In general, in CNC lathes, programming is done through canned cycles; that provide great comfort and time savings to the programmer. Here the canned cycles to program and machine threads are presented.

Additional learning materials

The additional learning materials consist, mainly, in interactive activities to be perform by the students , once he has check the corresponding learning unit, so as to reinforce the acquired knowledge.

- Activity 1. Coordinates 1.
- Activity 1. Coordinates 2.
- Activity 1. Coordinates 3.
- Activity 1. Coordinates 4.
- Activity 3.
- Activity 4. Looking for.
- Activity 5. Complete.
- Activity 6.
- Activity 7.
- Activity 8.

Organization of the activities

Each of them is related to a specific learning unit. The number on the name of the activity stands for the learning unit at which it belongs. Check the next table:

Activity	LU	Activity type
Activity 1. Coordinates 1	1	Drag and drop
Activity 1. Coordinates 2	1	Drag and drop
Activity 1. Coordinates 3	1	Drag and drop
Activity 1. Coordinates 4	1	Drag and drop
Activity 3	3	Drag the words
Activity 4. Looking for	4	Find hotspots
Activity 5. Complete	5	Drag and drop
Activity 6	6	Drag and drop
Activity 7	7	Drag and drop

Activity 8	8	Image pairing

Figure 68: Organization of the activities 5
Source: Own representation.

9.8.3 Classroom materials

The training approach for the implementation of the EDU-VET platform is blended learning, i.e. a section of the training program associated with this module is available online for the student; therefore he will be able to develop his learning process autonomously, while another section takes place in person in the workshops of the VET institution.

By taking both sections, the student will be able to achieve the professional competencies foreseen in each of the training modules included within the EDU-VET platform.

In the case of the workshop, the activities to be carried out by the student will be purely practical, i.e. only the execution of practical work on the machine tool that is the object of this module, the lathe, is foreseen. These activities have already been previously posted on the EDU-VET platform and have been studied by the student. In this way, the circle is closed, workshop time is optimized and full learning is achieved by the student.

The materials used in this part of the workshop are:

- Computer
- Internet connection
- Technical documentation as drawings, work sheets, etc.
- Raw material
- CNC lathe and its tools.
- Measurement devices as vernier caliper, micrometer, thread comb, etc.

9.9 Module 9: Experienced Drilling / Turning / Milling 3

This chapter addresses experienced drilling, turning, and milling within the EDUVET project learning modules. This is module 9.

At an experienced level, the learner is given much more detailed and complex tasks to complete. The learner uses the vital fundamental skills and knowledge that have been gained through previous modules and more relevant processes such as calculations are explored.

The objective of this course is to learn knowledge and understanding of NC programming in milling processes. It is important to understand, interpret and implement G-code in NC programmes.

The learning outcomes of this Learning Module are:

- Understand the coordenate system used in NC programming.
- Understand the basic movements in NC machines.
- Understand, interpret and implement NC programmes.

Furthermore, there are following learning units:

- *Learning Unit 1: Planes (G17)*
  This section presents an initial contact with the Numeric Control programming. It includes a brief introduction to the coordinate systems, so it will help us to get started in the course of milling in CNC machines.
- *Learning Unit 2: Incremental programming (G91)*
  This section explains the incremental programing.
- *Learning Unit 3: Absolute programming (G90)*
  This section explains the absolute programing
- *Learning Unit 4: Definition stock (G30 - G31)*
  This section explains the definition stock.
- *Learning Unit 5: Programme structure*
  In this section, we will discuss the programme structure. We will do this by means of an example.
- *Learning Unit 6: Tool compensation*
  This section explains the definition tool compensation.
- *Learning Unit 7: Programme example and drawing*
  This section shows an example programme with a drawing.

Besides, you can also find additional learning tasks (H5P tasks) as well as the glossary and the chat.

References

EDU-VET LEARNING PLATFORM (2021): The EDU-VET Learning Platform. http://edu-vet.eduproject.eu. Erasmus+ Project EDU-VET: E-Learning, Digitisation and Units for Learning at VET schools – Creating online Learning Environments in Technical Education for European metal industry. Paderborn 2020.

Part D – Practical relevance of EDU-VET results

10. Insights into the guideline concept for teachers

Jana Stelzer

The following chapter contains insights into the guideline concept for teachers. The aim is to provide teachers with a guide on how to use the EDU-VET learning platform. This concept is intended to provide a fundamental orientation and can be expanded at any time and adapted to individual needs or contexts.

First of all, it must be mentioned that the guideline concept for teachers contains a frame concept as well as a detailed concept. The frame concept addresses the theoretical basis. The detailed concept serves to concretise the frame concept, which includes detailed contents and project planning.

Following that, a theoretical background will be presented. Afterwards, the concretisation of the guideline concept will be addresses.

10.1 Theoretical basis of guideline concept

The guideline concept is essentially based on two models. From the technical view, the DISK approach according to BEUTNER / PECHUEL(2021) is fundamental. On the other hand, and from a pedagogical-didactic level, the 3C-Model according to KERRES / DE WITT (2003) is leading.

DISK approach – BEUTNER / PECHUEL (2021)

"DISK-Online stands for Didactic Interactive Streaming Know-how and this approach is designed for providing a quick solution to tackle the problems schools have when forced to implement distance learning in times of a pandemic" (BEUTNER / PECHUEL 2021, p. 180).

In principle, the concept comprises 4 interaction levels, which will be discussed in more detail below. The first level has a low level of knowledge about online interaction, while the last level requires a high level of interaction (cf. IBID.).

DISK 1

This level is teacher-oriented and it "is the easiest implementation level which offers simple teaching situations online in which the teacher shares the screen of a tablet and his or her voice in a live stream" (IBID., p. 181). Moreover, the communication between the teacher and the

student is 1:1. Learners can either be present and actively interact with each other in the classroom or be connected online or learn online from home, but without any digital interaction (cf. IBID.).

DISK 2

The second interaction stage is based on the first DISK 1 – level. The interactive communication within the face-to-face setting remains. At this level, the teacher can stream the lessons via different platforms and communicate with the students. But also, communication via chat is possible, for example (cf. IBID., p. 182).

DISK 3

The implementation stage of interaction level 3 (DISK 3) expands the DISK 2 – level, because communication between learners is now possible at this level via video or text chat and/ or voice (cf. IBID.). Additionally, BEUTNER / PECHUEL explain that "the idea from a teacher-centred concept to one that focuses on the learners" (IBID.).

DISK 4

DISK 4 combines all levels and is an extension to DISK 3 – level. At this level, communication between online learners and learners in the classroom is possible. Learning processes are clearly in focus (cf. IBID.).

Summarised, from a technical point of view, the DISK approach forms the basic component for the guideline concept.

3C-Model – KERRES / DE WITT (2003)

The development of the 3C-Model model is based on approaches of hybrid learning arrangements, which "involve the combination of different didactic methods [...] and media presentation and communication formats [...]" (KERRES 2005, p. 163).

Basically, the 3C-Model consists of three basic components: *Communication, Content, Construction* (cf. KERRES / DE WITT 2003, p. 109). KERRES / DE WITT summarised these components as follows:

"- a *content* component that makes learning material available to a learner

- a *communication* component that offers interpersonal exchange between learners or learners and tutors and

- a *constructive* component that facilitates and guides individual as well as cooperative learning activities to actively operate on learning tasks (or assignments) with different degrees of complexity (from multiple-choice to projects or problem based learning)" (IBID.).

Content

On the occasion of the first component *conten*t the provision of learning materials for the learners is intended (cf. KERRES 2005, p. 169). These should stimulate "cognitive and motivational-emotional processes [...]" (IBID.). Special attention is paid to this element in the medial or technological transfer of knowledge and content (cf. KERRES / DE WITT 2003, p. 105). This knowledge is the requirement for further communicative or constructive learning activities. In addition, the authors recommend presenting other information or matters via this chosen media channel (cf. IBID.).

Communication

The *communication* component focuses on an interactive exchange between all participants in a virtual learning environment (cf. KERRES 2005, p. 169). Against this background, interaction can take place between peers or between teachers and learners, in individual conversations or within groups (cf. IBID.). KERRES and DE WITT see this component as necessary if the acquired repertoire has a certain degree of complexity, in which theoretical contexts are not only theoretical contexts can not only be deepened, but also linked to other issues. Furthermore, the learners should be able to develop their own position in group discussions (cf. KERRES / DE WITT 2003, p. 105).

Construction

The c*onstruction* component completes the 3C frame model. Within this dimension, the focus is on "both individual and cooperative learning activities" (KERRES 2005, p. 169). It is important to design these learning activities in this way, that a representative solution results from them, for example in the form of a written elaboration (cf. IBID.). This component is used when transfer of knowledge content is required, which is primarily refer to processual rather than declarative knowledge (cf. KERRES / DE WITT 2003, p. 105).

10.2 Development of guideline concept for teachers

The concretisation is about a detailed planning and preparation of the framework of the concept. The choice of media is assigned and adapted to the didactic structure described above.

Definition of the teaching objectives

The first step is to define the teaching objectives. This is an important instrument for planning and controlling teaching units and forms the basis for the evaluation of teaching processes. For example, BLOOM's taxonomy serves as an orientation for the formulation of tasks and teaching objectives (cf. KRATHWOHL / BLOOM / MASIA 1978).

Preparation of the didactic contents

In addition to the rough didactic structure of a blended learning approach, the selection and preparation of concrete learning content is of central importance. The transfer of content to e-learning must be adapted accordingly (cf. KERRES / DE WITT 2003).

Media choice and methodology

When choosing the media, the results of the preceding aspects must be taken into account. An important principle of design-oriented media didactics is that media and methods cannot be equated. It is true that the two factors influence each other; certain methods suggest certain media and, conversely, certain media are particularly well suited to specific methods. Nevertheless, there are many combinations of these two elements and the choice of media and methods can also be adapted to the needs of learners and teachers. Therefore, requirements for the medium result from the specification of the intended goals and the analysis of further parameters of the didactic field (cf. KERRES 2018, p. 129).

Additionally HOWE specify six potential categories *"Making information and content available", "Visualising, animating and simulating", "Communicating and cooperating", "Structuring and systematising", "Diagnosing and testing*" and *"Reflecting*" (cf. HOWE 2013, p. 1).

Making information and content available: Traditionally, information and content are mostly conveyed through print media such as textbooks, which can now be transferred into digital form such as mails, podcasts or educational videos. Content can be researched, shared, stored and accessed as needed (cf. IBID., pp. 5-6).

Visualising, animating and simulating: Work tasks and process sequences can be abstracted with the help of graphics, videos and animations and are suitable for illustrating complex procedures of work processes and objects. Effects and experimental design can be additionally supported by simulations such as virtual reality (cf. IBID., pp. 6-7).

Communicating and cooperating: Forums, chats or blogs are communication channels in which participants can coordinate with each other and work on tasks together. In addition, whiteboards can be used to jointly edit and add content. Other coordination media include group diaries, to-do lists, project management systems, etc. (cf. IBID., pp. 7-8).

Structuring and systematising: Simple programmes for spreadsheets, presentations or text documentation can be used to structure information. Mind-mapping tools and keyword systems are also useful for collating different materials and can be helpful in the thematic subdivision of subject content (cf. IBID., pp. 8-9).

Diagnosing and testing: Test media such as digital single- or multiple-choice tests or open-ended questions can be used to conduct an initial needs analysis or continuous learning status checks. Another possibility are classroom response systems, where participants anonymously give an answer to an assignment and send it to a server where the results can be immediately evaluated and presented virtually (cf. IBID., pp. 9-11).

Reflecting: The creation of portfolios by the learners can help them to reflect on the course of their learning process so far by constantly making new links to older materials when documenting their work. In addition, self-assessment of their own competences is possible through questioning (cf. IBID., pp. 11-12).

From a pedagogical-didactic perspective, HOWE points out that "with the help of the categories presented, teachers and trainers […] differentiate existing e-learning offerings such as learning software, web-based training, learning platforms, etc. in terms of their quality and scope for designing be able to assess vocational training processes. But the other way round, it is also possible to reflect on the extent to which one's own e-learning arrangements already use the diverse possibilities of digital media and the Internet" (IBID, p. 12). Against this background, teachers should ask themselves the following guiding questions: "Which categories are currently the main focus and which categories have been thought about less or not at all so far?" (IBID.).

10.3 Recommendations for teachers

Based on the above, the following design principles can be identified.

1. Definition of the technical framework conditions

At the beginning, a classroom session should take place to inform the learners about organisational framework conditions, the course sequence or the content planning. In addition,

the technological basics and modes of operation should be explained in order to prepare everyone involved for the blended learning programme. Getting to know each other and the teacher builds initial contacts and increases motivation.

2. Planning of a blended learning concept

A blended learning concept should be created in an interdisciplinary way and be uniform and coordinated for all courses. A cooperation of participants from different areas such as vocational school, companies and learning programmers is therefore necessary to control the course of the project. For this purpose, it is helpful to introduce a project management which takes over tasks such as planning, monitoring and evaluating the project situation.

3. Securing the digital infrastructure

The digital infrastructure should be ensured at schools. Every teacher and learner should have access to the used digital media. In addition, it is helpful to have a technical contact person on site in case of technical problems.

4. Structuring of online and face-to-face phases

The two units should not be completely separated from each other, but rather complement or cohere. For example, content from the online phase can be repeated, summarised, deepened or practised within the classroom event. As a result, the classroom units must also be made more interactive.

5. User-friendly presentation of the contents

Access to e-learning materials should be clear and user-friendly. Learning platforms should be permanently updated and maintained with new content and users should not be overwhelmed with too much or confusing content. Improving the general handling with the learning management system leads to a higher application of the users.

6. Weighing up the workload with the content

Due to the online phases that have been introduced, students have to organise themselves to some extent in terms of time and content, which is why it is important to adapt the learning effort. Teachers can quickly underestimate the time and effort required for individual content and not include it in their planning.

7. Observation and evaluation of learning outcomes

The evaluation and observation of learning outcomes through regular self-tests or control tasks, especially from the self-study phases, are important in order to adapt further content or methods. In addition, it also serves to give students feedback on their learning process and motivates them to achieve new teaching objectives.

8. Feedback culture

Feedback and suggestions from students as well as teachers can help to improve the course design and motivate learners. Opportunities to do this should be introduced regularly.

9. Design of the communication processes

Interaction with each other should not be lost through e-learning, but should be promoted through collaborative learning. In addition, care should be taken not to neglect communication, especially in the self-learning phases, and also to stimulate exchange among learners on questions and problem solving.

10. Fostering of digital competence

Teachers should familiarise themselves with the use of media before starting blended learning and be supported in various ways by contact persons or with tutorials to introduce them to the various functions of the e-learning systems. Further education and training can also be helpful to improve media competences.

Finally, from the concept it follows that blended learning offers numerous opportunities and possibilities through the use of diverse methods to design lessons. Various competences can be promoted through action-oriented tasks and cooperative learning. Classroom settings often cannot sufficiently establish action contexts, which makes the transfer into practice more difficult. Blended learning requires a high degree of willingness to change on the part of providers and participants.

Therefore, the guideline concept offers a first approach to facing the changes, caused by the digital transformation as well as the COVID 19 – pandemic.

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11. Insights into best practice showcases

Jana Stelzer / José Luis Souto Otero

To show how metal companies integrate new ways of digitisation into training the EDU-VET consortium creates an online tool where amongst others, VET teachers, VET trainers and learners can find information of practical examples of digitisation and industry 4.0 in the metal VET field. The tool provides insights into real existing showcases and offer pictures and videos of best practices examples.

The objectives of this EDU-VET Online Showroom are:

(1) to present role models for metal enterprises and enterprise owners to inspire learning and teaching processes and to provide realistic information for teaching processes;

(2) to provide instant access to a library of information resources identified by partners during the research process that might be useful to teachers;

(3) to provide a range of online environments and forums where teachers and VET professionals can exchange ideas and practices with their peers in partner countries, and collaborate.

11.1 The EDU-VET Online Showroom

In this context, the best practices thus act as a role model for learners as well as teachers and trainers of the VET sector of the metal industry. Furthermore, the experiences of the best practices can be a fundamental help for the development of ideas and the further professional future. Consequently, the online observatory offers access to valuable and useful information resources, which can be accessed at any time and which will be continuously expanded during the research process. Ultimately, the Online Observatory aims to provide a forum for sharing experiences, practices and other concerns within the topic of digitisation in the metal VET sector can be exchanged.

The EDU-VET Online Showroom will be an online hosted environment running on a web server tailored for the purpose. It will be built on a Content Management System, based on the framework of IKs technical experts. This framework is a scalable, includes features such as language versioning, object relations and ownership models, all with a flexible connection interface. The core technologies behind the framework are Open-Source and include PHP, MySQL Database, Apache Web service and an adequate server. The object-based and modular nature of the framework and the services built on it allow for flexible combining of the available

modules as well as cost-efficient creation of new ones should the need for special purpose-built extensions arise.

The Online Showroom is Web 2.0 enabled and caters for all mainstream social networking activities and is developed in all partner languages. The portal is optimized for mobile access and functions equally well on laptop, tablet or smartphone. The proposed technology infrastructure is developed to accessibility compliance standards. The online showroom also includes features like rss feeds from appropriate organisations to ensure that the information available through the portal is always up to date. It is fully web 2.0 compliant and includes all the standard and expected social media features that are now an essential part of online learning.

The partners have collected the showcases and all information and put them together according to a description guideline. This guideline is based on criteria which will be used in the showroom presentation of the information, too. The partners have collected graphics, videos, text descriptions on the enterprises, their processes, aims and target groups as well as on contact data, perspectives and pedagogical hints for schools. Moreover, a description of the enterprise and how the use digitisation in the metal VET training is provided together with contact data. In total, there are at least 20 showcases in the observatory.

In order to be able to fill the platform with content, the project is guided by a general guideline that will be used as a basis for each project partner. Preferably, interviews (face-to-face, telephone, online) should be conducted with the metal companies. Here, the interviews must first be organised. This means that metal enterprises have to be identified and contacted. In this step an introduction to the EDU-VET project as well as explanations of the further procedure and the objectives of the online platform was addressed. If the metal entrepreneurs are interested, they can be invited for an interview, e.g. via e-mail or telephone. In addition, finding a date and a venue and the determination of a meeting place contribute to the success of the interviews. If a personal meeting is not possible because of the Corona pandemic, the interview can also be conducted by video conference or telephone. During the interviews, it is important to ask questions in a coherent and consistent way so that the answers and finally the content of the internet platform are authentic and complete.

At this point, the project uses the *EDU-VET Business Profile*. This instrument can be used to create a company profile. First of all, the name and the year of foundation of the company are noted. The categorisation into areas, e. g. Industry, Services, IT, etc. provides all interested parties a better orientation and clarity of the online observatory. The classification is followed by a description of the business context and the products or services. Facts such as turnover

figures or the number of customers/employees can be entered in the next step. Particularly relevant for learners are the aspects of supports the companies accessed when setting up their business and digital learning and teaching processes in their enterprise, i.e. financial, mentoring, technical aspects, organizational aspects, professional services, marketing, etc. Moreover, this observatory is aimed at teachers and learners. Therefore, the following questions, for example, are also interesting for the target group from the perspective of the companies: If you were to look at digital learning and teaching processes and your business again, could you mention something you would do differently this time? Are there any pitfalls to setting up digital learning and teaching processes which new businesses should be aware of? What are the main challenges you faced in this sector? Finally, an outlook on digital learning in metal education rounds off the questionnaire. In addition to that, video material as well as logos can also be made available online.

To get an impression of such a completed business profile, you will find an example of the German company Metallbau Welsing – H-T-W Metall- und Fassadenbau GmbH below. This table serves as a basic structure for the content implementation of the Online Showroom.

EDU-VET Business Profile	
1. Name of the business	Metallbau Welsing – H-T-W Metall- und Fassadenbau GmbH
2. Years in business	1971
3. Category of business	Services in the metal sector
4. Description of business and digitisation	Metal and steel construction includes a variety of structural and aesthetic solutions. The combination with other materials results in structural craftsmanship that can be used both indoors and outdoors. We advise planners, builders and architects in Paderborn and the surrounding area in the planning and implementation of aesthetic yet functional solutions. Our custom-made metal products meet the requirements of the industry as well as fire protection tasks. Whether in the private, public or industrial sector, we produce individual metal solutions that contribute to creating a piece of quality of life. According to your specifications, we create a wide variety of metal products made to measure for the home, garden and industry: carports, canopies, steel staircases, steel structures, balcony and stair railings, terrace roofs, porch balconies, garden furniture and bikeports. Whether for house owners, industry or property management companies: Our many years of experience and comprehensive professional competence enable us to carry out the entire range of services from steel construction to locksmith work.

	Whether fences or garage doors, balconies, awnings or railings, doors or window grilles: we have the experience and expertise to ensure professional installations. Even solutions made of steel or metal in combination with other materials pose no problem for us. We are happy to provide you with our full service on site to help you turn your vision into reality. There are virtually no limits to the possibilities: With us, you will receive the complete services for your steel construction project in or near Paderborn. We are there for you from consultation, planning, production and construction to assembly. Our professional staff will carry out all work reliably and on schedule.
5. Size of your business	25 employees
6. Supports to set up your business and digitization	-
7. Pitfalls and challenges	-
8. Opportunities and plans for the future	-
Logo of business Maybe: enterprise film	www.metallbau-welsing.de *https://www.metallbau-welsing.de/upload/Fassadenbau-Dachblechmontage20200609-1005.mp4* WELSING METALLBAU FASSADENBAU BLECHBEARBEITUNG ABKANTTECHNIK 

Figure 69: EDU-VET Business Profile – Metallbau Welsing
Source: Own representation based on METALLBAU WELSING (2020).

11.2 Best practice showcases – some examples

The following chapter aims to show several examples of best practice showcases for VET within the metal field.

The EDU-VET Online Observatory can be accessed via the following link:

https://eduvet-observatory.eduproject.eu/

The online observatory tool is structured as follows and will be demonstrated in the next screenshots:

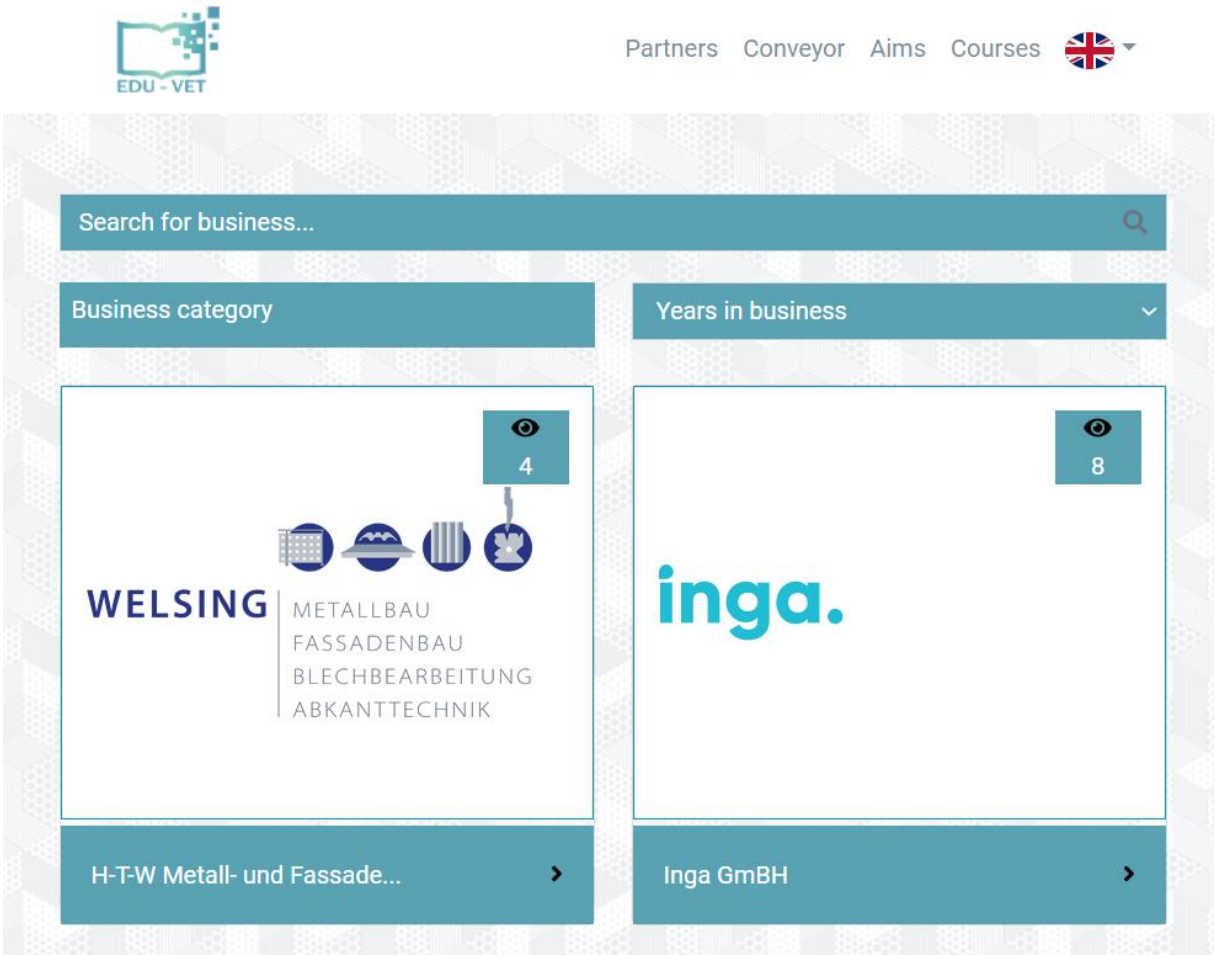

Figure 70: EDU-VET Online Observatory – Start page
Source: EDU-VET ONLINE OBSERVATORY (2022).

As you can see in the picture before, there is a search bar. This can be used to search for a company or a keyword. There are also further filter options. On the one hand, the user can filter according to the business category and on the other hand according to the years of businesses. All business profiles of the partner countries are listed below. In addition, it is possible to view the profiles in English as well as in the respective partner languages like German, Spanish or

Dutch. The individual profiles can be clicked on for further information. As an example, you can see the business profile of the German company Welsing Metallbau.

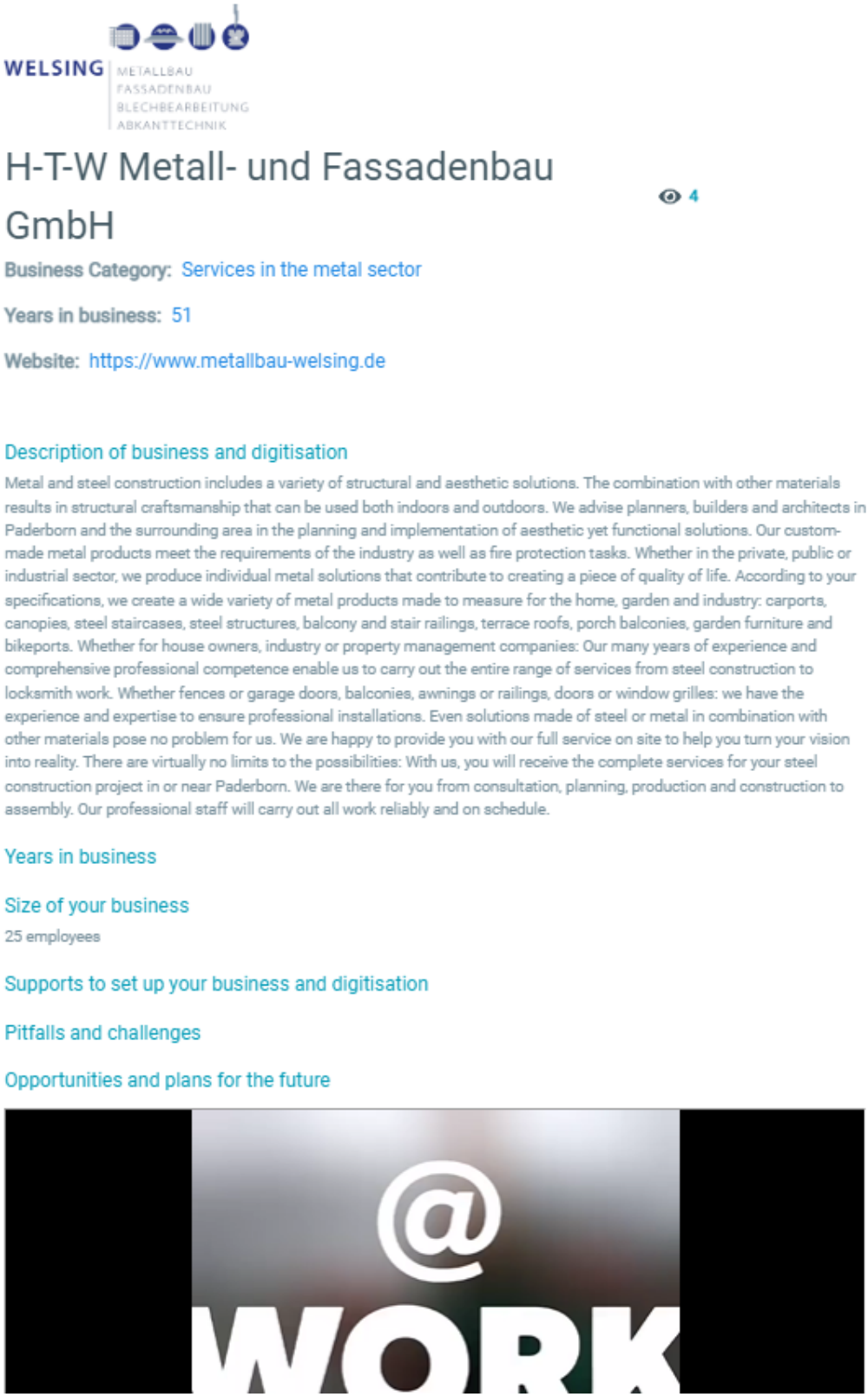

Figure 71: EDU-VET Online Observatory - Example of a Business Profile
Source: EDU-VET Online Observatory (2022).

The screenshot shows that, in addition to the company description, also references to digitalisation. Finally, the logo and a video round off the company presentation. Besides the users can find the link to the company's website. As this example is a German company, it is possible that the profile will also be displayed in German.

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Part E – The future of blended learning in the VET sector

12. A general view on future of blended learning in the VET education

Gert André

In order to create a positive learning environment, teachers using blended learning environments should encourage students for more participation in the environment and should find ways of creating social interaction through more collaboration. Furthermore, blending of face to face and online learning environments should be planned precisely in order to benefit more from this approach. Besides this, it is also found that blended learning is studied on different variety of schools and participants from postgraduate students to middle school students; from nursing to English courses and from training programs to high level courses at military. Therefore, all these examples indicates that blended learning will got increasing attention from different areas.

In near future, there should be more studies guiding teachers or administrators on how to create a successful blend. Moreover, near future will be dominated by tablets, smart phones and touch screen devices that will be some of the next interests to be studied in blended learning courses. As technological innovations spread, new types of blends will occur and education will be blended with different technologies but the key question to be answered will remain same “How should we organize such learning environments in order to support learning effectively?”.

The answer is we should study to integrate constructivist and collaborative models into blended learning environments and aim to educate more creative and curious students who reads, writes and produces for the world (Source: https://www.sciencedirect.com/science/article/pii/S187704281401009X).

12.1 The future of blended learning

Covid-19 has highlighted the importance of online learning in higher education, but what does the future hold for blended learning?

The pandemic has brought the importance of online learning into the spotlight, as well as the higher education institutions that struggled to quickly adapt and offer effective online support to their students. As we slowly emerge from the pandemic, we're seeing how universities' teaching methods have been impacted, and what important lessons have been learned.

It's hard to believe that a year ago, the term "blended learning", where online education is combined with traditional classroom-based methods, was virtually unheard of outside of the world of academia. But when the first lockdown was announced in March 2020, universities were forced to rapidly shift their teaching and learning resources online, subjecting their existing digital resources to the ultimate stress-test. This presented a whole host of obstacles for both students and lecturers.

As an online learning resource provider, whose innovative processes offer students studying STEM (science, technology, engineering and maths) modules in university video tutorials customised to their exact syllabus, Proprep was already ahead of the digital learning curve (Source: https://business-reporter.co.uk/2021/05/17/the-future-of-blended-learning/).

The beginning of the revolution in digital learning

Before Covid-19, teaching methods were already in need of an overhaul. A 2014 meta study confirmed that students studying STEM degrees using passive learning methods such as traditional lectures were 1.5 times more likely to fail. However, adopting an active learning model and putting the student at the centre of different teaching methods such as flipped, blended and online classes achieved far better learning outcomes. Also, multiple studies demonstrated that video is a highly effective educational tool, and shorter videos in particular allow students to process information more efficiently and have improved memory recall.

This research confirmed the methodology that Proprep, which launched in the UK in 2019, was already using to develop its study tools. Proprep placed short online video tutorials at the cornerstone of its successful blended learning model, which also includes online workbooks, study guides and practice questions and solutions.

Focusing on STEM subjects, and using award-winning artificial intelligence and a team of seasoned professors with more than a decade of experience, Proprep built a vast library of more

than 50,000 online video tutorials, all between five and seven minutes long. Proprep continues to add to this on a weekly basis and can develop resources customised to a specific university module, which includes 75 to 95 video tutorial hours and around 1,200 practice questions and study guides, in less than 20 minutes.

This technology has already achieved incredible results in Israel and the USA, with more than 500,000 students and lecturers relying on this innovative method to create learning materials (Source: https://business-reporter.co.uk/2021/05/17/the-future-of-blended-learning/).

Breaking down learning barriers

Suddenly, complicated STEM topics once deemed difficult to teach or learn could be carefully dissected into bite-sized videos that students could access at any time, from any device. This allowed students to learn at their own pace and ensured they had access to information that is laser-focused in its relevance to the student's specific course.

Universities were initially hesitant to adopt this dynamic approach to learning, but the pandemic forced their hand. Proprep's response to this mass exodus to online learning was to open all its resources to students, free of charge, for the entire academic year. Having already partnered with 25 student unions around the UK, Proprep also reached out to multiple universities to offer them access to its learning resources and analytics to track students' learning activity.

Keeping the student at the centre of Proprep's study resources helped demonstrate to universities and academic professionals alike that Proprep supplements students' learning, rather than trying to replace the lecturer.

This saves lecturers valuable time by enabling them to offer additional, reliable resources to their students via fresh learning content in a wide range of mediums. This means Proprep can support universities as well as students, in equal measure (Source: https://business-reporter.co.uk/2021/05/17/the-future-of-blended-learning/).

The future is active blended learning

As we cautiously approach normality, with a confirmed date set for students to return to campuses, this gives universities an exciting opportunity to embrace their newfound digital literacy. By continuing to fine-tune their online offerings, giving students access to active blended learning tools and recognising the capabilities of third-party tools such as Proprep, universities can reach incredible milestones. The barriers to difficult subjects can be slowly lowered as they become more accessible, with dropout rates reduced while students' academic results improve.

Gone are the days of having a job for life. In the 21st century careers are constantly changing, making certain skills obsolete in a matter of years. Continually changing your profession will soon become the norm, so being able to teach yourself new skills is essential. Students learning critical thinking, problem solving and self-learning skills at university will help ensure their ability to easily evolve and adapt to their workplace. For students and universities, a bright, post-pandemic future of enhanced digital learning is on the horizon (Source: https://business-reporter.co.uk/2021/05/17/the-future-of-blended-learning/).

12.2 Blended learning or Hybrid-learning

The impact of this ongoing global crisis has been enormous. Firstly, the sudden transition to online classes became an arduous journey for teachers, and secondly, the lack of peer contact took a toll on students. To keep learning flexibility intact while maintaining the COVID-19 protocols, educators planned to **create remote and hybrid learning environments for their students**. Many experts also believe that educators' new learning environments will continue to take shape even after the current crisis.

A survey by the RAND Corporation states that 10% of K-12 leaders will continue offering a blended or hybrid learning model even after the pandemic is over, and 20% said they would consider offering a fully remote learning environment to their students.

What precisely does a hybrid learning model involve?

In a hybrid learning setup, a teacher delivers live instructions in the classroom and online. This model can also use asynchronous (non-live) teaching methods to supplement synchronous, face-to-face instruction. **Video-based learning, pre-recorded lectures, online discussion forums,** etc., are some of the techniques that are helping students learn better.

Unlike blended learning, which restricts only one course, the classes with a hybrid learning model vary according to the course's requirement and specific learners' needs.

How hybrid learning will benefit students if implemented

While accepting the new normal is one thing, coming to grips with the real challenges is another. Still, educators and students successfully adapted distance learning when the educational sector nudged digitalizing learning programs. However, as mentioned above, the lack of peer interaction caused anxiety and stress among the students, and that's when hybrid learning came to the surface.

Flexibility in learning

Students have free will to decide how they learn on a subject-by-subject basis. One of the biggest advantages of **hybrid learning is that it gives the flexibility to choose both remote and in-person learning**. For example, if a student feels comfortable attending online lectures, they can opt for an online class. Simultaneously, if he/she wishes to clear doubts, can opt for **traditional classroom teaching**.

Along with online learning, students who face difficulties reaching a test center, let alone appear for in-person exams, can now give online exams with advanced technology (Source: https://www.proctortrack.com/blog/article/is-hybrid-learning-the-future-of-education-lets-find-out/).

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