UNIVERSAL DESIGN FOR LEARNING AND INTEGRATED DIGITAL DIDACTICS PRACTICES IN PHYSICAL EDUCATION IN LOWER SECONDARY SCHOOLS

UNIVERSAL DESIGN FOR LEARNING E PRATICHE DI DIDATTICA DIGITALE INTEGRATA NELL'INSEGNAMENTO DI EDUCAZIONE FISICA NELLA SCUOLA SECONDARIA DI I GRADO

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ABSTRACT
Universal Design for Learning is a framework for designing instruction that is accessible and effective for all learners, regardless of their learning styles or needs. Integrated Digital Didactics combines learning and digital settings in presence and at a distance ensuring maximum accessibility and inclusion. Universal Design for Learning well supports UDL as it promotes a fully inclusive curriculum through the strategic use of digital. A pilot study to explore the joint application of UDL and DDI in the teaching of Physical Education in secondary school is illustrated.

L'Universal Design for Learning è un framework per la progettazione di percorsi didattici accessibili ed efficaci per tutti gli studenti, indipendentemente dal loro stile o dalle loro esigenze di apprendimento. La Didattica Digitale Integrata coniuga setting di apprendimento e di digitalizzazione in presenza e a distanza assicurando massima accessibilità e inclusione. L'UDL ben supporta la DDI poiché promuove un curricolo del tutto inclusivo grazie anche all'utilizzo strategico del digitale. Viene illustrato uno studio pilota volto a esplorare l'applicazione congiunta dell'UDL e della DDI nell'insegnamento di Educazione Fisica nella scuola secondaria di 1°.

KEYWORDS
Integrated Digital Didactics, Universal Design for Learning, Inclusion, Flexible Design
Didattica Digitale Integrata, Universal Design for Learning, inclusione, progettazione flessibile

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Introduction

Integrated Digital Didactics (DDI) connotes an innovative pedagogical tool that promotes the systematic use of methodologies capable of combining learning and digitisation settings with the design of conjugated educational actions in presence and at a distance, ensuring maximum accessibility and inclusion. An all-encompassing methodology that can well support the implementation of Integrated Digital Didactics lies in Universal Design for Learning (UDL), which connotes an effective model for the realisation of educational products and environments that can be used by anyone and to a wide extent, without the need for specialised design or adaptations, and which enables the promotion of a fully inclusive curriculum thanks also to the strategic and reasoned use of the latest digital technologies. A pilot study to explore the joint application of UDL and DDI in the teaching of Physical Education in secondary school is presented.

1. Integrated Digital Didactics

The implementation of digital technologies in teaching-learning practices has been formally initiated with the MIUR Decree No. 39/2020 and the related *Guidelines for Integrated Digital Didactics* (DDI - DM 89/2020), which in the lockdown due to the COVID-19 provided a framework for each school to equip itself with a suitable operational plan.

By identifying the principles and methods for redesigning methodologies, learning environments and specific activities, the DDI plan must take into consideration the needs of all pupils, first of all safeguarding the conditions of difficulty – at any level – guaranteeing school attendance in presence and promoting the planning of educational pathways, also at home. The educational programming is thus optimised in respect of learning rhythms, integrating the teaching activities in presence with those at a distance, in synchronous and asynchronous mode, from which it can be deduced that distance teaching is only one of the tools that DDI uses in a structurally inclusive educational offer (Midoro, 2016).

The essential elements of a digitally integrated educational-didactic plan can be identified above all in a flexible classroom setting: furniture that is not fixed but mobile, chairs and benches with wheels so as to easily create various group aggregations, desks with unusual shapes, use of colours in the furnishings to make the environment pleasant, motivating and engaging.

Obviously, the possibility of using - by students and teachers - any personal electronic device (smartphone, tablet, portable PC) in integration with the technological equipment of the school, is implicit, thanks to BYOD (Bring Your Own

Device) perspective expressly provided by the *National Digital School Plan* (introduced by Law 107/15).
There is an evident need to adopt active teaching methodologies, typical of a pedagogical approach based on reality tasks and concrete experiential practices, which require interdisciplinary skills as well as collaborative and cooperative skills.
Integrated Digital Didactics connotes an educational modality that integrates digital technologies with traditional teaching, combining face-to-face and distance activities to create a hybrid learning environment.
The DDI is therefore an ideal tool for redesigning teaching practices and new learning environments capable of considering the needs of all pupils and safeguarding the most fragile situations. The methodological and didactic techniques and strategies most appropriate for the adoption of the DDI model are many, but they are all aimed at the development of multidisciplinary and transversal competences; here it is sufficient to recall those suggested by the Guidelines, including short didactics, cooperative learning, flipped classroom, debate, project-based learning, web-based learning, but above all the new emerging digital technologies such as systems guided by artificial intelligence, virtual and augmented reality, robotisation, and the Internet of Things (cfr. *DigComp 2.2* Framework).
It follows that DDI requires adequate technical and methodological skills on the part of the teacher and particular attention to the new intersubjective aspects of the educational relationship, and therefore it is to be considered a concrete and effective solution on a global level since it allows for the promotion of alternative teaching strategies to traditional educational practices, thanks to the integration of digital.

2. Universal Design for Learning and its contribution to Integrated Digital Didactics

The organization of a didactic plan integrated by the digital modality must avoid a mere transposition of what is provided in the presence, since different learning models intersect according to educational needs (Milito, Tataranni, 2019).
A comprehensive and articulated methodology that can well support the implementation of Integrated Digital Didactics is undoubtedly provided by Universal Design for Learning (UDL), which already in 2018 the Ministry of Education had indicated as a possible model for the construction of a fully inclusive curriculum (see the document *School autonomy for educational success*).

In pedagogical field, Universal Design for Learning was first deepened, starting from the early 90s, by CAST - *Center for Applied Special Technology* of Massachusetts, which defines it as an innovative approach to didactic design, based on the assumption that in knowledge processes diversity connotes the norm and that it is necessary to respond to this diversity, from the beginning, with a flexible and pluralistic training offer (CAST 2008, 2011, 2018, 2024)[1].

Universal Design for Learning therefore helps to prepare educational plans capable of coping with the variability of students, recommending flexibility and customization in the objectives, methods, materials and evaluation system.

In this way the school would be able to satisfy the needs not so much of a hypothetical "average" but of each distinct student, allowing each to progress from where they are to where they would like to arrive, preparing them for lifelong learning (CAST, 2011, 2018; Hall, Meyer and Rose, 2012; Savia, 2016).

It is, in essence, a way of designing and managing teaching practice that is attentive to the different possibilities and learning conditions that may arise in different contexts, with the primary objective of providing educational products and environments that are accessible to all and that guarantee everyone the same opportunities for educational success, regardless of the presence or absence of difficulties. Universal Design for Learning connotes «a set of principles for the design and development of paths that offer all individuals equal learning opportunities [...] not a one-size-fits-all solution [...] but the use of flexible approaches that can be customized and adaptable for the individual needs of each student» (Savia, 2016, p. 23).

The key word of the UDL methodology is therefore “flexibility”, understood as a tool for adapting, supporting and modifying the information, contents, knowledge offered to students, in such a way as to guarantee everyone the same conditions for their educational success.

It is worth briefly recalling the theoretical and scientific roots of Universal Design for Learning, which first of all draws on the evidence provided by various research sectors of cognitive psychology and learning sciences, in particular from the theories of cognitive and psychosocial development developed by Piaget, Vygotskij,

[1] First introduced in 2008, the UDL Guidelines are meant to be dynamic and continuously developed based on new research and feedback from practitioners. Since the release of Version 1.0 in 2008, CAST has released four iterations that trace our learning not only as an organization but as a broader UDL community. In 2020, CAST launched our most recent effort to update the UDL Guidelines, and the result of this process is the UDL Guidelines 3.0.

Bruner, Bloom, Gardner, from which derives the importance of understanding and considering individual differences and of developing adequate strategies to deal with them (Savia, 2015).

The contributions of neuroscience are also fundamental, starting from the first studies by Luria (1973) on brain functioning in learning situations up to the neuroscientific evidence of the last twenty years (e.g., Cytowic, 1996; see the summaries, among others, by Gazzaniga, Ivry, Mangun, 2015 or by Postle, 2016).

Considering the theoretical approaches and contributions of neuroscientific research mentioned above, CAST has set three principles to the fundamental assumptions of the UDL, in turn articulated in as many connected universal design practices for the learning, summarized as follows[2]:

1) UDL encourages teachers to *provide different means for engagement* (the "why" of learning), i.e. to look for more ways to motivate students: recruiting interest, sustaining effort and persistence, and self-regulation. An example is making skill development feel like a game and creating opportunities for students to get up and move around in the classroom. Other common strategies include the explicit learning of control strategies that allow pupils to self-regulate in the moments in which they experience a difficulty in the activity they are carrying out, or letting students make choices and giving them assignments that feel relevant to their lives.

2) UDL recommends offering information in more than one format (the "what" of learning), i.e. *provide different modes of representation*: perception, language and symbols, and comprehension. This principle involves making available a plurality of ways in support to perception and understanding of information through different languages. For example digital books with expansions, in which the written text is accompanied by audio, video and images files that can be activated by the students, gives all pupils a chance to access the material in whichever way is best suited to their learning strengths.

3) UDL suggests offering students different ways of interacting with the material and showing what they have learned (the "how" of learning), i.e. *providing various modes of action and expression*: physical action, expression and

[2] CAST's UDL Guidelines 3.0 builds upon previous iterations and emphasizes addressing barriers rooted in biases and systems of exclusion for learners with and without disabilities. This expanded version aims to fulfill the promise of the Guidelines as a resource to guide the design of learning environments and experiences that reduce barriers and more fully honor and value every learner (CAST, 2024).

communication, and executive function. A concrete example is the free choice of students to narrate in written rather than oral form, up to video format. Or students can choose between a pencil and paper test, an oral presentation or a group project.

These principles are the basis of an inclusive, flexible and fair training path, through which all students are guaranteed the possibility of achieving high learning standards, thanks to the engagement and motivation, to the proposal of different and diversified tools to represent the information, such as action and expression of knowledge. Therefore, the ultimate goal of Universal Design for Learning is to support teachers and educators for elaboration of curricula that guarantee equal learning opportunities for all students, or to identify objectives, methods, materials and evaluation models according to a flexible approach which allows an adaptation to individual needs. As we have anticipated, the three principles constitute the pillar of the UDL methodology; from them are articulated as many guidelines as possible, declined overall in thirty-one operational verification points and in numerous examples of implementation (figure 1).

The operational framework that can be deduced from the UDL structural model proves to be an worthwhile tool for teachers' work as it supports the awareness processes inherent in the design and consequent implementation of their teaching actions (from lesson or project planning to curricular planning) and provides food for thought to make their intervention more effective in terms of flexibility, integration and inclusiveness.

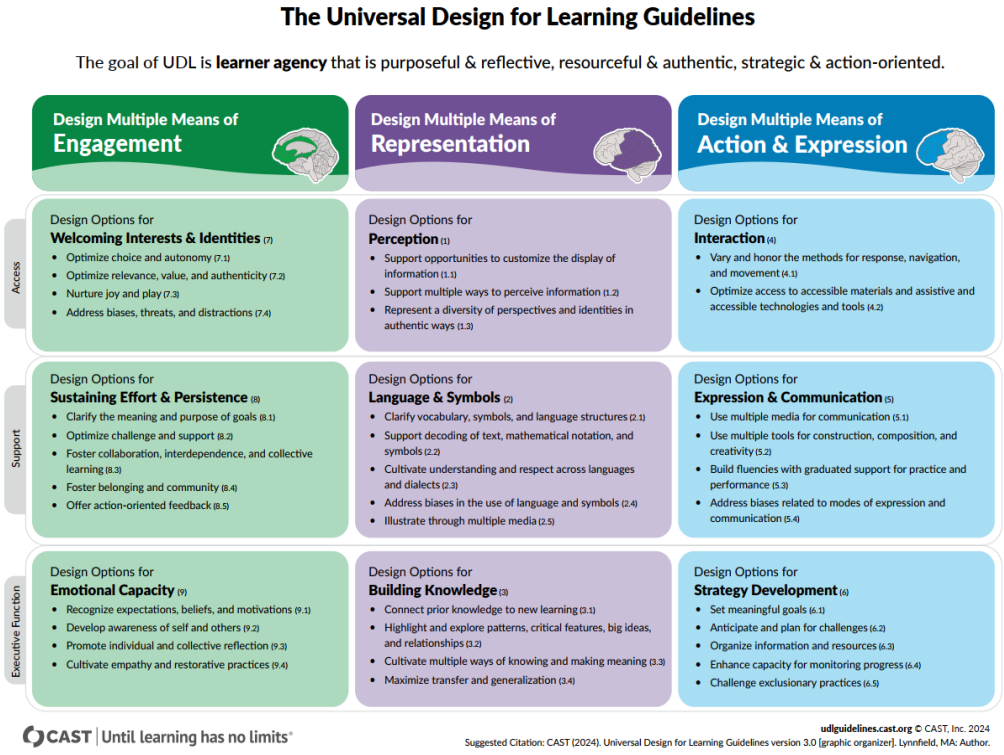

Figure 1. Structural model of Universal Design for Learning - UDL Guidelines (*version 3.0* - CAST, 2024).

3. Universal Design for Learning and digital technologies

The principles of UDL make it possible to experiment within curricular designs with different communication modes to promote learning skills such as selective attention and the ability to integrate new information with what is already known, restructuring the field of knowledge and not just adding new information

In the practice of UDL, the role of digital technology is significant. It has made it possible to design innovative and flexible learning environments that can be adapted to individual characteristics. The possibilities for the use of new technologies in the development of the courses are numerous and differentiated: they range from the use of the interactive whiteboard or tablets to the use of digital apps, software or specific and specialised technological devices. In fact, the use of digital technology in the application of UDL principles makes it possible to achieve easy and effective customisation of curricula, in ways that are ergonomically practical and advantageous with respect to both time and resource use.

It should obviously be emphasised that the tout court use of new technologies does not guarantee the automatic concretisation of the UDL methodological-didactic framework, since an inadequate application of digital technology could be a source of additional difficulties in the educational pathway, if not of discrimination or exclusion. In this regard, CAST itself clarified that «[...] using technology does not necessarily improve learning and many technologies have the same accessibility problems that non-technological options might have. Technology needs to be carefully planned into the curriculum as a means to achieve the goals» (CAST, 2011).

In any case, digital technologies respond to the need of the UDL approach to integrate supports, structures, challenges to help learners to know, understand and to be guided in engaging in both real (in-presence) and virtual (distance) learning environments. As mentioned above, digital technology in itself is not automatically synonymous with UDL, but plays an important role in its implementation and also in its conceptualisation in a feedback mechanism of choices and operations.

The multiplicity of tools, materials, and teaching methods envisaged by the UDL methodology concerns both a quantitative differentiation, relating to the complexity of the learning tasks, and a qualitative differentiation, achievable thanks to the consideration of operational-expressive and affective-motivational methods that are essential for some but useful for all (Savia, 2015; Baldassarre, Sasanelli, 2021).

4. A pilot study to explore the intertwining of UDL and DDI in the teaching of motor science in secondary school

In the teaching of motor and sports sciences, the joint use of Universal Design for Learning and Integrated Digital Didactics represents an innovative approach to promoting inclusion and enhancing individual differences by aiming-as repeatedly emphasized-to create flexible and accessible learning environments where the potential of digital technologies allow teaching actions to be adapted to the needs of individuals.

There are now numerous publications exploring the application of UDL in the motor and sports disciplines[3] which, by offering practical examples and theoretical reflections, highlight that this pedagogical model facilitates the elimination of

[3] It is suffice to mention here: Brian, Miedema (2019), Kennedy, Yun (2019), Lieberman *et al*. (2020), Galkienė, Monkevičienė (2021), Ambretti, Orecchio (2022), Belfiore *et al*. (2024).

barriers to learning and contributes to creating an accessible and inclusive curriculum for all, regardless of the abilities or background of individual students.
By involving cognitive, emotional and motor aspects in the teaching-learning process, the UDL guarantees the motor science teacher a flexible and effective methodological-didactic approach (Munafò, 2017; 2020), allowing, for example, to adapt the planned motor and sports activities, modifying them to suit the different needs of students, to use assistive technologies by employing digital tools to facilitate and support learning and participation, and to promote collaboration by encouraging group activities such as to encourage interaction and mutual support. Therefore, a pilot study was initiated in a not representative group of secondary school teachers to explore the adoption of the UDL design model in conjunction with Integrated Digital Didactics practices.
In the first cycle of education, motor and sports disciplines are currently declined in the terms of "Physical Education" (DM 254/2012 "National Guidelines for the Curriculum of Preschool and First Cycle of Education"[4]). However, it merits mentioning that the "New Guidelines of 2025"[5], currently under public consultation and in force from A.S. 2026-2027, introduce significant updates to respond to contemporary educational challenges, establishing for motor and sports activities a redefinition of their specific role as a fundamental element for the harmonious and integral development of the person, based on an interdisciplinary approach focused on well-being through the integration of mind, body and environment. In addition, it is worth highlighting that the New Guidelines underline that «…also educational technologies constitute an advanced front of the possibility of experimenting with useful strategies for inclusive school. These strategies, in line with the Universal Design for Learning reference framework, promote more accessible and diversified learning by offering personalized learning experiences...».
The teaching of Physical Education is therefore intentionally oriented toward flexibility and variability of learning, with the intention of making it transferable between various motor experiences. The teaching proposals involve the combination of motor, sports, structured and inclusive play activities, allowing the knowledge of rules and the acquisition of strategies for the management of one's actions in situations of competitive/agonistic and collaborative interaction.

[4] https://www.mim.gov.it/documents/20182/51310/DM+254_2012.pdf
[5] https://www.mim.gov.it/documents/20182/0/Nuove+indicazioni+2025.pdf/cebce5de-1e1d-12de-8252-79758c00a50b?version=1.0&t=1741684578272

Undoubtedly, DDI applied to motor and sports activities can enhance learning through the combination of digital tools, innovative technologies and active methodologies that include, among the most widely used, the following:

- *video tutorials and guided exercises*: students can watch videos demonstrating exercises or motor sequences (such as warming up, stretching, jumping techniques, etc.), or they can record their own performances to compare with the proposed ones, while also receiving feedback (useful tools: YouTube, Edpuzzle, Flip);
- *physical activity tracking apps and devices*: fitness trackers, smartwatches or apps (e.g., Google Fit, Strava) can be used to monitor parameters such as steps, heart rate or calories burned, or students can share data to reflect on daily motor activity;
- *augmented and virtual reality*: apps can be used that use augmented reality (AR) to visualize the human body in 3D, so as to facilitate understanding of how muscles work during movement, or immersive environments can be offered to access simulated workouts, such as virtual games, climbing techniques, etc. (useful tools: Human Anatomy Atlas, Quiver, Oculus VR);
- *creation of e-portfolio engines*: students are invited to document their progress, skills and reflections in a digital portfolio, or they can include videos, photos, graphs of their performance, enriching with personal comments (useful tools: Google Sites, Canva, Padlet);
- *gamification and interactive quizzes*: quizzes on topics such as nutrition, anatomy, sports rules, etc. can be used, or team competitions with scores and leaderboards can be promoted to make learning more engaging (useful tools: Kahoot!, Quizizz, Socrative);
- *hybrid and flipped classrooms*: students' study at home with digital materials (videos, articles, podcasts) and then apply what they have learned in the gym or outdoors with hands-on exercises.

The present study intends to carry out an exploratory analysis on the knowledge of UDL and the related use of DDI in a group of secondary school Physical Education teachers in the Northeast of Italy. As an implicit objective, we constructed a questionnaire based on the principles of UDL integrated with aspects of digital integrated teaching, which underwent a preliminary validation process in order to apply it on a wider scale

4.1. Research Design

The study envisages a cross-sectional research design with a convenience sample that does not allow the data to be extended to the entire reference population, using a factorial analysis of five subscales of the questionnaire built on the Universal Design for Learning model and Integrated Digital Didactics. The survey instrument was administered to a non-randomised group of secondary school physical education teachers from the Northeast of Italy. The data will be subjected to specific exploratory statistical analyses and discussed in the light of the research objectives, with reference to the literature on the subject.
The questionnaire consisted of 5 items related to UDL knowledge, 36 items taken from the UDL Guidelines version 3.0 (see Fig. 1), of which 13 items related to the principle of Engagement (the "why" of learning"), 12 items related to the principle of Representation (the "what" of learning") and 11 items related to the principle of Action and Expression (the "how" of learning").
Additional 6 items aimed to investigate the combined use of digital tools and active methodologies, both in synchronous and asynchronous mode.

4.1.1 Subjects

The participants in the study were teachers of Physical Education in Secondary School, from eight different provinces in the Veneto and Friuli Venezia Giulia regions who made up a group of volunteers who filled in the questionnaire; therefore, we speak of a "convenience sample", which can give an idea of the results as a point of reference for the teachers but does not allow the results obtained to be generalised to the whole population (Bosco, 2003, pp. 13-19).
A total of 108 secondary school physical education teachers participated in the study, of whom 42 were female and 66 male. The average number of years of teaching was 8.36 (SD=3.59), with no statistically significant differences in gender.

4.1.2 Materials and Methods

The instrument constructed for this empirical research is the "QUESTIONNAIRE on UDL and DDI" (Q-UDLDDI) – reported in the Appendix – composed of the following 47 items/statements:
- 5 items related to UDL knowledge;
- 36 items taken from the UDL Guidelines *version 3.0* (see Fig. 1), of which:
  (i) 13 related to the principle of Engagement (the "why" of learning), referring to the teacher's ability providing different means of engagement and motivation,
  (ii) 12 items related to the principle of Representation (the "what" of learning), referring to the teacher's ability providing information in different formats, i.e. different modes of representation,

(iii) 11 items related to the principle of Action and Expression (the "how" of learning"), referring to the teacher's ability providing multiple ways to interact with the material and demonstrate what students have learned.

- 6 items related the combined adoption of digital tools and active methodologies (DDI), both in synchronous and asynchronous mode.

The format of the answers is built on a Likert scale (Thomas, Nelson and Silverman, 2005), with 5 possible answers from "not at all agree" (expressed by answer 1) to "totally agree" (expressed by answer 5), in the middle there are three intermediate answers. The use of such a Likert scale makes it possible to treat the data as numerical (scale) rather than ordinal, as the distance between each neighbouring score is always equal (Bosco, 2003, pp. 37-40). The items include some with a positive meaning and others with a negative meaning (reverse items[6]) with inverse scores. There are five factors analysed and for each there is a different number of items between five and thirteen mixed within the questionnaire.

The appendix contains the Q-UDLDDI questionnaire constructed from the UDL model and DDI essentials, while the five factors that make up the instrument are listed below:

- Factor 1 - Knowledge of Universal Design for Learning (UDL)
- Factor 2 - Providing different means of Engagement
- Factor 3 - Providing different means of Representation
- Factor 4 - Providing different means of Action and Expression
- Factor 5 – Adoption of Integrated Digital Didactics (DDI)

Table 1 presents the subscales and coding of the items that make up the Q-UDLDDI.

Subscale	**Item**												
Factor 1	1	2	3	4	5								
Factor 2	6	7	8	9	10	11	12	13	14	15	16	17	18
Factor 3	19	20	21	22	23	24	25	26	27	28	29	30	
Factor 4	31	32	33	34	35	36	37	38	39	40	41		
Factor 5	41	43	44	45	46	47							

Note: The reverse items have already been converted and all the items have been arranged in an orderly and non-random way as in the administered questionnaire.

Table 1. Questionnaire on UDL and DDI (Q-UDLDDI).

[6] In survey research, reverse coding (also called reverse scoring) is a technique where the numerical values of responses to some items are inverted to ensure all\ items contribute in the same direction to a scale or construct. This helps prevent biases and ensures responses are consistent across items, even if some items are phrased negatively.

4.1.3 Statistical analyses

Statistical analyses were conducted using SPSS 21.0 and LISREL. In the first instance, exploratory analyses, meta-analyses, data reports, etc. were carried out in order to assess the correct arrangement of data and the normal distribution of the sample.
In order to assess the ability of the Q-UDLDDI to measure the 5 postulated factors, a Factor Analysis using the *Varimax rotation* method and the RMSEA (Root Mean Square Error of Approximation) were conducted, with which we checked whether the 5-factor model (multi-factor model) was confirmed or not.
The fit of the data to the factor analysis was checked by means of the KMO index (Kaiser-Meyer-Olkin) and Bartlett's sphericity test. *Cronbach's Alpha* was used for the reliability of the individual factors. The percentage of explained variance was also calculated, which consists of extracting factors from the questionnaire that explain a certain share of variance; the acceptable percentage is usually greater than 60%. The *Pearson correlation* coefficient was calculated to assess the presence of correlations between the variables in the whole sample and in the different groups analysed. Descriptive analyses (mean and standard deviation) were used to describe the whole sample and the scores obtained by the groups analysed (e.g., distinguished according to gender and years of teaching). Analysis of variance (ANOVA) and *Bonferroni's post-hoc test* were mainly used to analyse the differences between the groups in the factors of the Q-UDLDDI.

4.2 Results and Discussion

4.2.1 Internal Consistency

The reliability of the Q-UDLDDI questionnaire is high as can be seen from the following Cronbach's Alpha values for the five factors considered (table 2).

Factor	***Alpha***
Knowledge UDL	.95
Engagement	.96
Representation	.95
Action and Expression	.90
DDI	.97

Table 2. *Cronbach's Alpha coefficient.*

The reliability of the questionnaire is high overall, with Cronbach's Alpha values for the five factors ranging from .90 to .97.

4.2.2 Factor Analysis

Preliminary analyses were conducted with the KMO (Keiser Meyer Olkin) sampling adequacy test and with the Bartlett sphericity test. The first to define information relating to the sample examined which was found to be adequate with a value of .864; the second to obtain information relating to the applicability or otherwise of the factor analysis which proved to be significant (p<.0001).
The factor analysis on 47 items of questionnaire, conducted with Varimax rotation, allowed us to confirm that the five factors initially postulated are suitable to explain a good share of variance. In fact, they explain 87.2% of the total variance. From the decreasing graph of the eigenvalues (Fig. 2) it is evident that even by increasing the number of factors the percentage of explained variance would not increase much, therefore the model we followed a priori can be considered good and reliable.

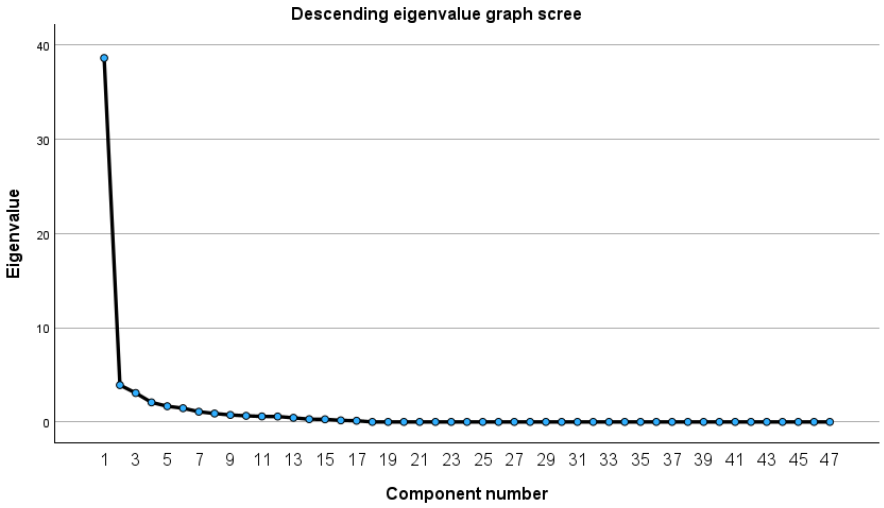

Figure 2. Graph scree.

Furthermore, factor analysis also allows us to obtain information regarding factorial saturation where the minimum threshold value is .40 (Ford, MacCallum and Tait, 1986). Looking at the data in Table 3, concerning factorial saturations, we can see that all values are above the minimum threshold.

Item	Knowledge UDL	Engagement	Representation	Action and Expression	DDI		Item	Knowledge UDL	Engagement	Representation	Action and Expression	DDI
Q1	.910						Q25			.749		
Q2	.890						Q26			.766		
Q3	.905						Q27			.756		
Q4	.894						Q28			.666		
Q5	.962						Q29			.658		
Q6		.911					Q30			.671		
Q7		.923					Q31				.788	
Q8		.908					Q32				.818	
Q9		.775					Q33				.880	
Q10		.867					Q34				.842	
Q11		.818					Q35				.884	
Q12		.747					Q36				.829	
Q13		.787					Q37				.799	
Q14		.743					Q38				.860	
Q15		.766					Q39				.920	
Q16		.656					Q40				.931	
Q17		.814					Q41				.828	
Q18		.756					Q42					.889
Q19			.874				Q43					.806
Q20			.896				Q44					.853
Q21			.905				Q45					.868
Q22			.829				Q46					.910
Q23			.753				Q47					.913
Q24			.797									

Note: Absolute value indices.

Table 3. Factorial saturations.

The results of the factor analysis confirm the validity of the 5-factor structure.

4.2.3 Correlation results

Table 4 shows the results of the Pearson correlation between variables "years of teaching" and "UDL knowledge", while table 5 presents the Pearson correlations between the variable "years of teaching" and the remaining four factors of the Q-UDLDDI questionnaire: "Engagement", "Representation", "Action and Expression", "DDI".

	Knowledge UDL	Pearson correlation	Sign. two tails	IC 95% inferior	IC 95% superior
Years of teaching		-.953	<.001	-.968	-.932

Table 4. Pearson correlation between "years of teaching" and "UDL knowledge".

Table 4 shows that there is a high and significant negative correlation between years of teaching and knowledge of UDL. This indicates that teachers with more years of service have less knowledge of the UDL methodology in the whole sample.

	Years of teaching	Engagement	Representation	Action and Expression	DDI
Years of teaching	1	-.779 <.001	-.802 <.001	-.776 <.001	-.862 <.001
Engagement	-.779 <.001	1	.873 <.001	.923 <.001	.836 <.001
Representation	-.802 <.001	.873 <.001	1	.898 <.001	.967 <.001
Action and Expression	-.776 <.001	.923 <.001	.898 <.001	1	.837 <.001
DDI	-.862 <.001	.836 <.001	.967 <.001	.837 <.001	1

Table 5. Pearson correlations between "years of teaching" and the remaining four factors of Q-UDLDDI.

Similar to UDL knowledge, there is also a negative correlation with years of teaching for the other four factors. Teachers with more years of teaching report less familiarity in designing multiple means of engagement, representation, action and expression and in adopting digital didactic-methodological practices.
The factors “engagement”, “representation”, “action and expression” and “DDI” appear to be significantly correlated with each other.

4.2.4 Descriptive analyses

Table 6 shows the descriptive analyses (mean and standard deviation) of the whole sample, Table 7 shows the results of the descriptive analyses and the analysis of variance in relation to gender, and Table 8 shows the descriptive scaling and ANOVA with Bonferroni’s post-hoc test by year of teaching, referring to the five factors of the Q-UDLDDI questionnaire.

Variable	Whole sample (n=108)	
	M	SD
Years of teaching	8.39	3.59
Knowledge UDL	3.46	1.07
Engagement	3.66	.905
Representation	3.79	.810
Action and Expression	3.85	.880
DDI	3.67	1.22

Table 6. Scale descriptors on the whole sample.

Table 6 shows that in the full sample, the average teaching age is 8.39 years, with a high variability, while for the five factors of the Q-UDLDDI, the average scores are fair.

		Years of teaching	Knowledge UDL	Engagement	Representation	Action and Expression	DDI
F	M	8.57	3.60	3.67	3.95	3.97	3.88
	SD	3.93	1.20	.95	.82	.88	1.32
M	M	8.27	3.36	3.66	3.69	3.78	3.53
	SD	3.39	.98	.88	.79	.88	1.14
Tot.	M	8.39	3.46	3.66	3.79	3.85	3.67
	SD	3.59	1.07	.91	.81	.88	1.22

Note: No significant differences in gender.

Table 7. Descriptive scaling and ANOVA female teachers and male teachers.

Table 7 shows the averages and standard deviations (SD) of the "years of teaching" scale and the five factors of the Q-UDLDDI, from which no significant differences were found.

	3-5 anni (n=30)		6-10 anni (n=48)		11-15 anni (n=30)		*p-value*	Effect Size *Cohen's d*
	M	SD	M	SD	M	SD		
Knowledge UDL	4.76	.08	3.42	.65	2.20	.34	<.001	1.59
Engagement	4.44	.43	3.82	.57	2.61	.69	<.001	.93
Representation	4.51	.21	3.92	.69	2.85	.31	<.001	.99
Action and Expression	4.58	.25	4.00	.76	2.89	.56	<.001	.89
DDI	4.76	.17	3.93	.98	2.13	.27	<.001	1.47

Note: Bonferroni's post-hoc test showed the following differences between groups: 3-5 years > 6-10 years > 11-15 years ($p < .001$).

Table 8. *Descriptive scaling and ANOVAs by band of teaching years.*

As can be seen from Table 8, dividing the teachers by teaching age group on an ordinal scale (three groups: 3-5 years, 6-10 years, 11-15 years), significant differences emerge with regard to all five factors of the Q-UDLDDI. Those who have been in service for 3-5 years are found to have excellent scores in all five factors; those who have been in service for 6-10 years are found to have fair scores and in line with the averages of the total sample, while the 11-15 year service group has poor scores. In short, when broken down on an ordinal scale by years of service, teachers demonstrate less mastery of both UDL methodology and the use of innovative digital teaching methodologies.

5. Conclusions and future prospects

The UDL approach not only supports but, in many respects, can overlap with the methodological axis of Integrated Digital Didactics. In fact, the teaching profession requires on the one hand the ability to remove barriers that can lead to forms of exclusion and on the other hand to know how to build virtual learning environments in which students can be protagonists of their own schooling and can actively participate in the construction of knowledge thanks to the use of multiple technological tools and resources.

Therefore, the Universal Design for Learning methodology fully crosses the innovative system proposed by Integrated Digital Didactics understood as a complementary modality to "in-person school" and "distance school" as - through

the support of digital technologies - it ensures sustainability of the teaching-learning and inclusive processes, as well as particular attention to vulnerable pupils. This methodology, more than others, appears capable of contributing effectively to the educational context, thanks to the methodological strategy of placing individual differences at the centre of the design of learning environments, which "represent the founding element of universality" (Sgambelluri, 2020, p. 246).

The integration of UDL and DDI brings many advantages, including a level of global inclusion, the enhancement of motivation and sense of self-efficacy, the development of digital and metacognitive skills, a more effective personalization of motor learning.

The UDL, by expanding the use of digital and providing for the construction of a flexible and equally effective curriculum for all students according to a truly inclusive pedagogical vision, 'forces' the school to review not only its teaching methods but also its learning environments and spaces.

The UDL facilitates the personalisation and individualisation of educational pathways through a differentiated proposal offered to all and justified by the possibility of using various educational-didactic means to enrich pupils' learning right from the start.

In conclusion, educational policies increasingly highlight the potential of digital technology to reform or even transform teaching and learning practices in school contexts.

The need for students and teachers to have full access to digital technology is to be seen as a matter of democracy; hence, the orientation towards established DDI practices is crucial and urgent for children and students to be able to participate, develop and contribute to active citizenship in the digitised society of today and tomorrow.

5.1 Prospective future

In the future, it is envisaged to carry out validation and application studies of the Q-UDLDDI questionnaire on a representative randomized sample of Motor Education, Physical Education and Motor and Sport Science teachers of the various levels of education in Italy, in order to analyze the intersection of the variables at more specific levels of analysis, considering not only the general UDL organization in the three principles of involvement, representation, action and expression but also the options most used to maximize the learning opportunities for each student through the implementation of innovative didactic-methodological actions, making combined use of digital tools and active methodologies also in asynchronous contexts (DDI).

We believe that once validated on a randomised sample, the questionnaire could be a useful tool for developing longitudinal and experimental research studies to assess the effectiveness of teacher training interventions at the initial or ongoing service level. In particular, future studies will explore the methodological intertwining of UDL&DDI in physical education and motor sciences in both the first and second cycles of education, analysing the practices considered most effective by teachers and verifying their actual use in daily teaching activities (video tutorials rather than e-portfolios or augmented reality), naturally taking into account the conditions of actual applicability in ordinary school contexts, especially in relation to structural and organisational constraints.

Author contributions

Conceptualisation and co-ordination (Stefano Scarpa); extension (Elena Zambianchi); writing original draft (Zambianchi); writing the theoretical frame of reference (Zambianchi); developing the empirical research design and data analysis (Scarpa); final writing, revision and editing (Scarpa and Zambianchi).

References

Ambretti, A. & Orecchio, F. (2022). Universal Design for Learning and motor-sports activities for inclusive teaching. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, *2*(2).

Baldassarre, M. & Sasanelli L.D. (2021). UDL and Inclusive Technologies: state of the art and models for implementation UDL e Tecnologie Inclusive: stato dell'arte e modelli per l'implementazione. *QTimes – Journal of Education, Technology and Social Studies*, XIII, 3, 153-171, Open Access.

Belfiore, P., Martiniello, L. & Saraiello, E. (2024). L'insegnante di Educazione Fisica come facilitatore dei processi di inclusione nella prospettiva dello Universal Design for Learning. *ISSN 1828-4582-Anno XLI*, 213.

Bosco, A. (2003). *Come si costruisce un questionario*. Roma: Carocci.

Brian, A. & Miedema, S.T. (2019). Universal Design For Learning In Physical Education. *Teaching about social justice issues in physical education*, 85.

CAST (2008). *Universal design for learning guidelines version 1.0*; (2011) *UDL version 2.0*; (2018) *UDL version 2.2*. Retrieved from http://udlguidelines.cast.org

CAST (2024). *Universal Design for Learning Guidelines version 3.0*. Retrieved from http://udlguidelines.cast.org

Cytowic, R.E. (1996). *The neurological side of neurospychology*. Cambridge, MA: MIT Press.

Galkienė, A. & Monkevičienė O. (2021), (Eds.). *Improving Inclusive Education through Universal Design for Learning*. Springer Nature Books, Open Access.

Gazzaniga, M.S, Ivry, R.B., Mangun, G.R. (2015). *Neuroscienze cognitive*. 2^ Ed. Zanichelli Editore.

Hall, T.E., Meyer A. & Rose D.H. (2012). *Universal Design for Learning in the classroom*. New York-London: The Guilford Press.

Kennedy, W., & Yun, J. (2019). Universal design for learning as a curriculum development tool in physical education. *Journal of Physical Education, Recreation & Dance*, *90*(6), 25-31.

Lieberman, L. J., Grenier, M., Brian, A. & Arndt, K. (2020). *Universal design for learning in physical education*. Human Kinetics.

Luria A.R. (1973). *Working brain: An introduction to neuropsychology*. New York: Basic Books. Trad it. *Come lavora il cervello. Introduzione alla neuropsicologia*. Bologna: Il Mulino, 1977.

Midoro, V. (2016). *La scuola ai tempi del digitale. Istruzioni per costruire una scuola nuova*. Milano: Franco Angeli.

Milito, D. & Tataranni, A. (2019). *Didattica innovativa nell'era digitale*. Anicia: Roma.

MIUR - DM n. 39/2020. *Documento per la pianificazione delle attività scolastiche, educative e formative in tutte le Istituzioni del Sistema nazionale di Istruzione*.

MIUR –DM 89/2020. *Linee guida per la didattica digitale integrata*.

Munafò, C. (2017). Towards a New Culture in Physical Education with the Universal Design for Learning. *International Journal of Sport Culture and Science*, *5*(1), 1-10.

Munafò, C. (2020). L'Universal Design for Learning in Educazione Fisica Educare.it - *Open Access*, 20 (3), 53-60.

Postle, B.R. (2016). *Neuroscienze cognitive. L'essenziale*. Milano: Edra Edizioni.

Savia, G. (2015). Progettazione Universale per l'Apprendimento: un valido approccio per l'inclusione di tutti. *Rivista Educare.it*, 15(3), 52-56.

Savia, G. (2016), (a cura di). *Universal Design for learning: la progettazione universale per l'apprendimento per una didattica inclusiva*. Trento: Erickson.

Sgambelluri, R. (2020). L'Universal Design for Learning per una didattica a misura dello studente. *Education Sciences & Society - Open Access*, 1, 241-254.

Thomas, J.R., Nelson, J.K. & Silverman, S.J. (2005). *Research Methods in Physical Activity.* Champaign, IL: Human Kinetics.

Vuorikari, R., Kluzer, S. and Punie, Y., (2022). *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes*. Publications Office of the European Union, Luxembourg.

Appendix

Q-UDLDDI

Questionnaire about knowledge and use of Universal Design for Learning in conjunction with Integrated Digital Didactics

Dear teacher, we kindly ask you to answer this questionnaire aimed at exploring the educational-didactic strategies and methods of personalizing interventions in your subject area of affiliation. The questionnaire consists of 47 items and requires between 20-30 minutes to complete.

GENERAL INFORMATION

a) Role: □ Fixed-term □ Permanent
b) How many years have I been teaching _____ (*indicate*)
c) Age _____ (*indicate*)
d) Gender: □ Female □ Male □ Non-binary □ I prefer not to answer

Referring to your professional practice, for each statement, we kindly ask you to indicate your level of agreement, using a scale from 1 (*completely disagree*) to 5 (*completely agree*) points.

PART A - UDL[§] (From: CAST 2024. *Guidelines for Universal Learning Design Version 3.0*)		
	Knowledge and application of UDL	*From 1 to 5*
Q1	I know the goals of Universal Design for Learning methodology (UDL)	
Q2	I've heard about UDL	
Q3	I took a UDL refresher course	
Q4	I don't know UDL	
Q5	I apply UDL with my students	
	Design Multiple Means of Engagement	*From 1 to 5*
Q6	I optimize choice and autonomy (7.1)	
Q7	I optimize relevance, value, and authenticity (7.2)	
Q8	I nurture joy and play (7.3)	
Q9	I address biases, threats, and distractions (7.4)	
Q10	I clarify the meaning and purpose of goals (8.1)	

[§] The numbers in brackets in each indicator refer to the UDL framework version 3.0 shown in figure 1.

Q11	I optimize challenge and support (8.2)	
Q12	I foster collaboration, interdependence, and collective learning (8.3)	
Q13	I foster belonging and community (8.4)	
Q14	I offer action-oriented feedback (8.5)	
Q15	I recognize expectations, beliefs, and motivations (9.1)	
Q16	I develop awareness of self and others (9.2)	
Q17	I promote individual and collective reflection (9.3)	
Q18	I cultivate empathy and restorative practices (9.4)	
	Design Multiple Means of Representation	*From 1 to 5*
Q19	I support opportunities to customize the display of information (1.1)	
Q20	I support multiple ways to perceive information (1.2)	
Q21	I represent a diversity of perspectives and identities in authentic ways (1.3)	
Q22	I clarify vocabulary, symbols, and language structures (2.1)	
Q23	I support decoding of text, mathematical notation, and symbols (2.2)	
Q24	I cultivate understanding and respect across languages and dialects (2.3)	
Q25	I address biases in the use of language and symbols (2.4)	
Q26	I illustrate through multiple media (2.5)	
Q27	I connect prior knowledge to new learning (3.1)	
Q28	I highlight and explore patterns, critical features, big ideas, and relationships (3.2)	
Q29	I cultivate multiple ways of knowing and making meaning (3.3)	
Q30	I maximize transfer and generalization (3.4)	
	Design Multiple Means of Action & Expression	*From 1 to 5*
Q31	I vary and honor the methods for response, navigation, and movement (4.1)	
Q32	I optimize access to accessible materials and assistive and accessible technologies and tools (4.2)	
Q33	I use multiple media for communication (5.1)	
Q34	I use multiple tools for construction, composition, and creativity (5.2)	
Q35	I build fluencies with graduated support for practice and performance (5.3)	
Q36	I address biases related to modes of expression and communication (5.4)	
Q37	I set meaningful goals (6.1)	
Q38	I anticipate and plan for challenges (6.2)	
Q39	I organize information and resources (6.3)	
Q40	I enhance capacity for monitoring progress (6.4)	
Q41	I challenge exclusionary practices (6.5)	

	PART B - DDI (Derived and adapted from: DM 89/2020 *Guidelines for Integrated Digital Didactics and DigComp 2.2 Framework*)	
	To implement the didactic-methodological actions indicated above, I make combined use of digital tools and active methodologies – even in asynchronous contexts – including:	*From 1 to 5*
Q42	*Video tutorials and guided exercises*: e.g. slow motion animations of the technical gesture	
Q43	*Apps for monitoring physical activity*: e.g. pedometers, heart rate useful for recording improvements	
Q44	*Augmented and guided reality*: e.g. apps that allow 3D visualization to facilitate understanding of the functioning of muscles during movement or to simulate training	
Q45	*Creation of motor e-portfolios*: e.g. registration by the student of their own performance to upload to the platform	
Q46	*Gamification and interactive quizzes*: platforms for creating motor quizzes or challenges	
Q47	*Hybrid lessons and flipped classrooms*: e.g. video lessons, both synchronous and asynchronous, to show exercises or analyze technical gestures	

We thank you for your kind and appreciated participation