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Education 4.0 and national talent development: A conceptual synthesis of purposes, provision and evidence

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ABSTRACT

Education 4.0 is discussed as a means of preparing people for changing economic and social conditions, but its contribution to national talent development requires clarification. This conceptual article examines the contribution through the relationship between educational purposes, developmental provision and supporting evidence. Using a theory synthesis approach, it brings together purposively selected Education 4.0 frameworks, accounts of talent development and scholarship on educational purposes. Economic relevance, societal responsiveness, and individuals' opportunities and agency provide perspectives for examining the same educational arrangement. University-industry curriculum collaboration illustrates the analysis. Selected Moroccan policy documents and research provide a contextual illustration rather than a policy evaluation.

The synthesis distinguishes evidence of competency gains from judgments about whose needs provision serves, about learners' participation and about outstanding attainment within a domain. It also examines how institutional opportunities connect to accessible support across developmental stages.

Evidence supporting one of these judgments may leave others unresolved. The article offers an analytical framework for examining claims about Education 4.0 and national talent development while keeping recommendations, empirical findings and interpretations distinct. Its scope is bounded by the purposive corpus and the different contexts of the sources. The article does not establish causal effects or validate a national model.

Key words: Education 4.0; national talent development; educational purposes; conceptual synthesis; Morocco.

1. INTRODUCTION

Preparing people for changing working environments is one concern around which discussions of Education 4.0 have developed. Bonfield et al. (2020) describe Education 4.0 as a broad orientation towards preparing a future workforce rather than a specific educational intervention. Within this orientation, the significance of technology depends on the educational choices surrounding its use. Miranda et al. (2021) emphasize that introducing digital technologies does not itself constitute educational innovation, their purpose and integration with teaching and learning matter. Connecting Education 4.0 with talent development therefore involves considering the opportunities education provides and the purposes those opportunities are intended to serve.

At the national level, these purposes extend beyond preparation for employment. For example, the talent-development framework proposed by Muyia et al. (2018) connects education, industry, strategic leadership and individuals' ownership of learning, while incorporating citizenship and equitable participation alongside competitiveness. Brown and Tannock (2009) likewise direct attention beyond the quantity of talent available to the kinds developed and the ends they serve. These contributions establish a basis for examining educational provision through economic, societal and individual perspectives.

When these perspectives are brought to bear on a particular arrangement, recognizing several purposes does not establish how that arrangement contributes to each of them. Evidence concerning employment-related competencies, for example, leaves distinct questions about societal relevance and learners' involvement in their development. Biesta (2007) provides a basis for examining this distinction by arguing that knowledge of effectiveness alone is insufficient for educational decisions. His account also emphasizes that educational means are not neutral in relation to their ends. The issue pursued here is consequently how the purposes assigned to Education 4.0 relate to its educational arrangements and to the evidence supporting their anticipated contribution.

This article addresses the following research question: **How can the contribution of Education 4.0 to national talent development be examined through the relationship between educational purposes, developmental provision and available evidence?**

The object of analysis is the contribution attributed to educational arrangements, what they are intended to serve, how they organize developmental support and what can reasonably be concluded about them. The national dimension concerns the relationship between opportunities across institutions and developmental stages. Individual attainment, institutional provision and the organization of support therefore enter the analysis at distinct levels.

The synthesis brings economic, societal and individual perspectives to bear on the same arrangement. Its contribution is a bounded analytical framework for separating the judgments involved when an Education 4.0 arrangement is presented as supporting talent development. University-industry curriculum collaboration illustrates the distinction between evidence of competency gains, the justification of curricular priorities and the organization of continuing support. This application does not claim to discover the plurality of educational purposes. It makes explicit how existing perspectives change the interpretation of an arrangement and which conclusions remain open. Selected Moroccan policy documents and research findings provide a contextual illustration of that distinction.

2. METHODOLOGY

We use a conceptual research design informed by Jaakkola's (2020) theory synthesis approach. The article connects Education 4.0, talent development and educational purposes to examine claims about developmental provision. We assembled the corpus iteratively and purposively. A source was retained if it helped to define the central concepts, identify educational arrangements, examine their purposes or interpret evidence about participation and outcomes. The selection does not provide exhaustive coverage of these fields.

The sources serve different parts of the analysis, and we pay attention to differences in their scope and concepts. Education 4.0 frameworks describe the components of educational provision. Talent is defined in terms of outstanding attainment (Gagné, 2015). Its development is considered through trajectories involving opportunities and support (Subotnik et al., 2011), including access to resources and connections

across developmental stages (Ziegler et al., 2025). The national perspective brings education, industry, leadership and individual ownership into the analysis (Muyia et al., 2018). Scholarship on educational purposes informs our examination of the relationship between educational means and ends (Biesta, 2007). In the national perspective, talent development has a broader meaning than talent attainment as defined in this article, and we keep this distinction when bringing the sources together.

For each perspective, we compare the purposes identified with the arrangements proposed or examined and with the claims the evidence supports. In doing so, we keep the sources' conceptual recommendations and empirical findings separate from our own interpretations. Research on participation and institutional collaboration in other educational fields informs those parts of the discussion, but it is not used to establish the effectiveness of Education 4.0 or the attainment of talent. The Moroccan sources play two roles: policy documents describe intended purposes and proposed arrangements, while research studies give accounts of practice within the settings they investigated.

University-industry curriculum collaboration illustrates this comparison. It links the industrial orientation of Education 4.0 with decisions about curricula and institutional support. We constructed the illustration from several sources; it is not a case that their authors investigated jointly. Table 1 brings together the resulting judgments. The synthesis offers a basis for examining contributions, but it does not establish causal effects, rank educational purposes universally or validate a national model. Its scope is limited by the purposive selection of sources and by their different contexts, and other potentially relevant frameworks have not been compared exhaustively.

3. CONCEPTUAL FOUNDATIONS

3.1. Education 4.0 and its core components

Education 4.0 brings together competency development, teaching practices, technology and institutional provision. Preparing a future workforce for Industry 4.0 is part of this broad educational orientation (Bonfield et al., 2020). Its organization into four components (competencies, learning methods, information and communication technologies, and infrastructure) offers a way to examine what educational provision involves (Miranda et al., 2021). In this article, these components guide the analysis of educational choices. The framework itself does not establish which combination would be sufficient to achieve the intended outcomes.

How students learn is distinguished from how education is delivered in Miranda et al.'s (2021) framework. The authors also argue that introducing technology is not, in itself, educational innovation, its purpose and its relationship with teaching and learning practices matter. The inclusion of face-to-face, online, blended and hybrid learning in another Education 4.0 framework further allows for different forms of delivery (Khupe et al., 2026). Our reading of these accounts therefore focuses on the organization of learning, with no single delivery mode treated as a defining condition of Education 4.0.

Three configurations were identified in a review of computer-science teaching publications: EDU4 light, project-based/hands-on learning, and full EDU4 (Rienties et al., 2023). Each combines pedagogical characteristics found in the reviewed publications. The categories illustrate variation in practices associated with Education 4.0 within computer-science teaching, rather than ranking their effectiveness.

The capabilities expected of students include collaborative and communication skills, technological skills, learning skills and personal characteristics. These categories emerged from interviews with ten experts at one university (Himmetoglu et al., 2020). They describe expectations in that setting, rather than measured proficiency or an agreed profile applicable to all students. The institutional responsibilities extend beyond students, a review of Education 4.0 and skills frameworks recommends addressing both soft and hard skills among students, teachers and managers (González-Pérez & Ramírez-Montoya, 2022). We draw on these accounts to consider both the capabilities education aims to develop and those needed by the people who organize it.

An emphasis on generic Fourth Industrial Revolution skills can, however, leave the knowledge to be taught and learned in the background, as argued in an analysis of South African educational discourse (Fataar, 2020). This critique draws our attention to a choice that lists of desirable skills do not resolve, the knowledge and domains through which those skills are developed. That choice is relevant to our analysis because the definition of talent adopted in this article is domain specific.

The conditions for learning depend partly on the facilities, services and systems that institutions provide. These are included within infrastructure, together with considerations of comfort, sustainability and accessibility, in Miranda et al.'s (2021) framework. Other work addresses institutional guidelines, organisational processes and training in teachers' digital skills (González-Pérez & Ramírez-Montoya, 2022). A review of implementation barriers groups concerns around human resources, infrastructure, finance, partnerships,

educational management, learners, and health and environment (Costan et al., 2021). We draw on these accounts to examine the support surrounding curricular and pedagogical choices, beyond the technological tools available in classrooms.

Teaching-quality evaluation and procedures for diploma issuance, accreditation and verification are included under assessment and quality assurance in Chituc's (2021) framework. It retains traditional assessment methods and calls for attention to ethics and fairness when artificial intelligence supports assessment. Equity, inclusion, accessibility and the digital divide also have an explicit place in the socio-ethical dimension proposed by Khupe et al. (2026). Existing frameworks therefore address these concerns. Whether the proposed arrangements lead to equitable educational outcomes is a separate matter.

The reviews and frameworks also acknowledge limits in the available evidence. Higher education, particularly engineering, accounts for much of the literature examined by Souza and Debs (2024), whose review could not establish the impact of the methodologies studied. Further research is needed on the benefits of Education 4.0 elements (Rienties et al., 2023), and further empirical work is acknowledged as necessary in the frameworks discussed here (Khupe et al., 2026; Miranda et al., 2021). In this article, we use these contributions to examine how curricular aims, learning arrangements and institutional support relate to one another. They help describe educational provision, while any claim about its developmental contribution must be supported by evidence addressing the outcome in question.

3.2. Talent development and its national orientation

Gallardo-Gallardo et al. (2013) distinguish definitions of talent that concern people's attributes from those that designate people as talent. In the workplace literature they examine, the latter can encompass an entire workforce or selected groups. Because the term varies in this way, the meaning adopted here needs to be specified. The present article follows Gagné (2015), who distinguishes outstanding natural abilities from competencies developed through learning and training. In his model, talent refers to the outstanding mastery of systematically developed knowledge and skills within a domain, at a level that places an individual among the top 10% of learning or training peers. This criterion separates talent from competence acquisition in general. We retain it as a conceptual reference rather than applying it to classify individuals.

For the present analysis, this definition makes a claim about talent development more demanding than a claim about learning gains. Improved competencies can be relevant to a developmental trajectory without establishing outstanding attainment. The article examines the support through which such trajectories may become possible; it does not use a performance threshold to determine eligibility for that support. Access to developmental opportunities and evidence that exceptional attainment has occurred are separate judgments.

Gagné's (2015) model also incorporates intrapersonal and environmental influences on development and so provides a basis for considering the conditions surrounding the acquisition of outstanding competencies. Subotnik et al. (2011) offer a related developmental perspective, with transitions from abilities to competencies, expertise and eminence. Their model recognizes differences in developmental timing across domains and includes opportunities within and beyond school, alongside financial resources and social and cultural capital. Their terminology and endpoint differ from Gagné's definition. Here, their contribution informs the discussion of developmental trajectories and supporting opportunities, without making eminence the criterion for every use of the term talent.

At the national level, the focus shifts towards the organization of support. Ziegler et al. (2025) propose a framework for examining national talent-support systems and their resource relationships. They distinguish the existence of resources from their accessibility and recommend connected support across developmental stages towards excellence. These conceptual recommendations draw attention to who can use available provision and how separate opportunities relate to continuing development. As the authors acknowledge, the effectiveness of their approach remains open to investigation.

Muyia et al. (2018) address national development through a broader definition that combines the development of knowledge, skills and capabilities with the nurturing of innate abilities for societal and economic benefit. Their proposed framework for Kenya connects strategic leadership, education, industry and individuals' motivation and ownership of learning. It also assigns a place to citizenship, equitable participation and national competitiveness. We retain this framework for its treatment of national actors and purposes, while distinguishing its broader definition from the attainment-based meaning adopted in this article.

Each account has a particular role in the synthesis: defining talent attainment (Gagné, 2015), examining developmental trajectories (Subotnik et al., 2011), considering support through relationships among resources (Ziegler et al., 2025), and addressing actors and purposes at the national level (Muyia et al., 2018). We bring them together to examine where institutional provision fits within a longer developmental trajectory. From this perspective, what an opportunity offers immediately is only part of its relevance; its accessibility and its connections to further support also matter. Our national analysis focuses on these connections among opportunities and actors, without combining local competency gains into a national measure of talent.

3.3. Economic, societal and individual purposes of talent development

Defining talent as outstanding attainment leaves open which domains should receive support and whose purposes that support should serve. We examine these choices through three perspectives drawn from the selected literature: work and productive activity, collective needs, and individuals' opportunities and agency. The perspectives overlap. Participation belongs to the societal perspective when the question is whose needs shape provision, and to the individual perspective when the question is learners' involvement in their education. Accessibility can matter to both. We therefore use the perspectives to make different judgments about the same arrangement, rather than assigning each feature to a single category.

According to Schultz (1961), education and training are among the investments through which people can improve the quality and productivity of their work. Investment in people can also widen the choices available to them, although uncertainty and imperfect knowledge mean that observed returns may be negative, zero or positive. This account gives us an economic rationale for educational investment whose significance extends beyond productivity. It informs our treatment of the economic purposes assigned to talent support, but it does not establish the returns to that support or to Education 4.0.

In the social-efficiency perspective that Labaree (1997) examines in American education, preparing people for economic roles is treated as a public good. Human-capital scholarship also does not necessarily disregard benefits of education that are not expressed in monetary terms (Tan, 2014). Taking together with Schultz's account, these arguments complicate a simple division between economic purposes serving private returns and societal purposes serving public benefit. We therefore distinguish the perspectives by the reasons given for supporting education. Whether benefits accrue to individuals or to society does not, by itself, separate economics from societal purposes.

McGrath and Powell (2016) treat human development and sustainable development as inseparable in vocational education and training. They argue that skills development should support individuals' agencies while recognizing the structural conditions that constrain it, and they assign it a role in addressing poverty, inequality and injustice. In their view, the questions they raise require responses developed in specific contexts through participatory processes. These arguments inform our examination of the social purposes assigned to talent support. Vocational skills development, however, remains distinct from the outstanding competencies used to define talent in this article.

For Biesta (2020), subjectification concerns a person's freedom to act, or to refrain from acting, within a world shared with others. It is neither the unrestricted pursuit of personal wishes nor a further student achievement to be tested. This account shapes our attention to learners as participants in their educational lives. It does not change our definition of talent, and our economic, societal and individual perspectives are not equivalents of qualification, socialization and subjectification.

In two Finnish primary schools, Juvonen et al. (2024) identified instances in which socialization and subjectification were interpreted through the logic of qualification, and they propose separating the content of qualification from its logic. Their findings come from a different educational context, but the distinction helps us keep educational purposes conceptually separate from measurable attainment. In this article, Gagné's (2015) criterion defines talent; it is not used to judge whether every purpose associated with educational support has been fulfilled.

For Brown and Tannock (2009), the kinds of talent developed and the ends they serve matter alongside the amount of talent available. This argument links the definition of talent to the question of educational purposes, without deriving those purposes from an attainment threshold.

The three perspectives therefore ask different things of the same provision. The economic perspective examines its relationship with work and productive capabilities. The societal perspective considers collective needs and participation in defining them. The individual perspective concerns learners' opportunities and their role in their own educational lives. We treat these as related questions, not interchangeable indicators. An arrangement can be examined

from each perspective, but evidence relevant to one judgment may leave the others unresolved.

4. EDUCATION 4.0 AND THE ORIENTATION OF NATIONAL TALENT DEVELOPMENT

4.1. Education 4.0 and economic priorities

Linking Education 4.0 with economic priorities involves two questions: which capabilities industry seeks, and through which educational arrangements those capabilities might be developed. Saniuk et al. (2023) surveyed 50 selected Polish industrial enterprises, which identified a shortage of qualified employees as a prominent reported obstacle to Industry 4.0 implementation. Alongside technical skills, respondents sought problem-solving, analytical and communication abilities, the use of information systems, and continued learning. These findings describe expectations within the enterprises surveyed and are not a universal ranking of skills. We read them, nonetheless, as suggesting that the economic case for adapting education can extend beyond technical proficiency.

Within their Education 4.0 framework, Costa et al. (2022) recommend partnerships between industry and educational institutions to modernise curricula and provide internships directed towards Industry 4.0 skills. We read this proposal to identify an arrangement through which industrial requirements could inform education. As a recommendation, it does not show that such partnerships improve employment outcomes.

Using data from 486 Indian higher education institutions, Borah et al. (2021) found positive associations between both course-based and project-based collaborations and graduates' domain-specific competency scores. Course-based collaborations were also positively associated with the three generic competencies measured: English, logical reasoning and quantitative aptitude. For project-based collaborations, the corresponding coefficients were not statistically significant. When interpreting these findings, we therefore keep the type of collaboration and the competencies assessed apart. Because the results are observational, they show associations; they cannot demonstrate that collaboration alone produced differences in scores.

Institutional conditions also shape participation. In their broader analysis of 2,280 Indian institutions, Borah et al. (2021) found that academic autonomy was positively associated with teaching-focused collaboration overall, although the association was not statistically significant within the project-based subgroup. Access to the government-supported intermediary examined in their study was also positively associated with participation. These findings place industrial collaboration within a particular institutional environment. They point to the conditions that allow institutions to engage with industry, but whether they apply in other national settings is still an open question.

Some learning activities are built directly around industrial processes. In the mixed-reality virtual learning factory developed by Bondin and Zammit (2025), students could compare production configurations using measures such as output per minute and part quality. We see this as an example of how production decisions can be brought into a learning activity. The study did not examine long-term knowledge retention, and the authors identified continued investment in staff training, technical support and infrastructure as a possible requirement for wider adoption. What matters for our analysis is the learning opportunity the environment provides. Implementing it is a different matter from showing improved workplace performance, lasting capability development or adoption across an educational system.

How future skill requirements are understood also affects decisions about provision. Wilson (2013) argues that quantitative models can make the assumptions behind forecasts explicit and open to scrutiny but cannot prescribe exactly what education and training should provide. He also argues that the relationship between education, skills and the economy works in both directions, so educational choices can themselves help shape future economic trajectories. We therefore treat anticipation as a basis for informed educational choices, not as a set of requirements that education simply must follow.

Marginson (2019) cautions against assuming an automatic connection between higher education and employment outcomes. His account helps us place curriculum partnerships within the conditions in which institutions operate. Costa et al.'s (2022) framework recommends such partnerships as an educational arrangement, and the associations reported by Borah et al. (2021) vary with the form of collaboration and the competencies assessed.

Taken together, these arguments lead us to examine how anticipated skill needs inform curricular choices and how institutions are supported in pursuing them. An industrial requirement does not, on its own, specify a suitable curriculum or establish what that curriculum will achieve. Judging a partnership's contribution also means considering its form and the conditions that allow institutions to take part. At the national level, this points to how support is organized for forming and sustaining such arrangements. Throughout,

we keep the employability competencies examined by Borah et al. (2021) distinct from obtaining employment.

4.2. Education 4.0 and societal priorities

McCowan (2016) argues that a development-oriented higher education system should distribute its benefits in the interests of society. He distinguishes societal need from demand backed by purchasing power: provision that follows such demand need not coincide with societal need. He also assigns universities a role in investigating societal challenges, developing responses and providing space whereas broad range of social groups as possible can contribute to defining development. This argument leads us to ask whose needs inform educational priorities and whose perspectives enter the decisions behind them.

Wedekind et al. (2021) examine the relationship between educational provision and its surroundings through regional skills ecosystems. In Alice, South Africa, the vocational curriculum closely resembled that of urban colleges, despite a markedly different local labour market. In Gulu, Uganda, participants described a hierarchical vocational education system with insufficient space for stakeholder voice. The authors also describe Gulu University's participation in networks linking organizations and young people around vocational learning and livelihood opportunities, including agriculture and medicine. These cases give our attention to local relevance and to participation in educational decisions. We use them analytically, since the study does not evaluate Education 4.0.

In a survey of undergraduates at Rutgers University-New Brunswick, Katz et al. (2025) found that difficulties with devices, connectivity and instructor communication were associated with lower self-reported remote-learning proficiency. Greater proficiency was, in turn, associated with a lower likelihood of reporting incomplete grades and increased time to graduation, while device difficulties and financial hardship were associated with incomplete grades. The findings concern pandemic remote and hybrid learning at one university. They point us to the material and financial conditions surrounding participation, but they are associations rather than causal effects, and they do not address the effectiveness of Education 4.0.

Reviewing selected Education 4.0 frameworks, Khupe et al. (2026) interpret infrastructure as often appearing in the background of learning methods and technologies, rather than as a central design component. Their observation is about how those frameworks treat infrastructure, not about its availability across educational systems. Read alongside the findings of Katz et al. (2025), it helps us separate the place of technology in educational design from the conditions under which learners can actually use it. The link between the two studies is ours; neither study draws it.

Two judgments about societal contribution therefore need to be kept apart. McCowan (2016) and the cases examined by Wedekind et al. (2021) bear on which needs enter educational decisions and who takes part in defining them. Katz et al. (2025) and Khupe et al. (2026) bear on the conditions of use. We treat relevance and accessibility as related but distinct. Responding to a collective need does not show that the intended learners can participate, and widening access does not settle which purposes provision should serve. For talent support, the distinction concerns how developmental opportunities are organized and whom they reach, rather than whether exceptional attainment has been achieved.

4.3. Education 4.0 and individual's opportunities to develop their abilities

Rienties et al. (2023), reviewing computer-science teaching publications, found that student ownership of the curriculum was the least represented characteristic in the cluster they classified as full Education 4.0, although it was more prominent there than in the other clusters. The finding raises the question of what place learners occupy in arrangements described as Education 4.0. For our analysis, it is a reason to distinguish the opportunities offered to learners from their involvement in shaping those opportunities.

The designs reviewed by Bernacki et al. (2021) show several ways of organizing this involvement. Some let learners choose content, tasks and modes of presentation, as well as the order and timing of their engagement. Others worked at the whole-school level, combining flexible schedules, blended activities and interactions with teachers and peers around personal learning plans. Opportunities for individual development were thus addressed both through instructional choices and through changes to how education is organized. The review describes these arrangements; it does not show that learner choice improves outcomes.

Dumont and Ready (2023) recommend that the development of personalized learning technologies consider students' participation in constructing their learning experiences. They also recommend that such technologies address self-regulatory and socio-emotional needs. Their recommendations place participation alongside support. On this reading, adapting learning involves how students engage with the opportunities available to them, as well as what content they encounter. In discussing equity, the authors also

reject restricting appropriate learning opportunities for high-ability students as a response to differences in outcomes. Their position keeps a place for appropriately challenging provision within a wider concern for educational equity.

Dean's (2026) qualitative study gives a situated account of the support surrounding self-direction. Nine computing student tutors at an Irish university described learning driven by curiosity and by interests that went beyond their assignments. They also described peer interaction as helping them interpret material, check their understanding and stay motivated. These accounts suggest that autonomy can involve social support rather than solitary learning. They come, however, from a small, specialized sample and serve here only as supplementary evidence.

In their analysis of Danish talent provision, Rasmussen and Lingard (2018) found that, in practice, it appealed to students with substantial cultural capital and strong educational interests. The finding concerns Denmark, but it draws attention to the social circumstances surrounding participation. Robeyns (2006) argues that a complete analysis of educational policy should also examine constraints on learning beyond the provision of resources. These contributions suggest that understanding developmental opportunities requires attention both to the choices formally offered and to the circumstances in which learners engage with them.

Bernacki et al. (2021) also recommend transparent, accessible explanations of how personalized systems use learner characteristics to adapt instruction towards particular outcomes. The evidence base they identify is limited in size, scattered across studies and mostly correlational, which restricts confidence about the effects of specific design choices. Within the Education 4.0 literature, Rienties et al. (2023) call for research establishing which practices support particular groups of students and particular knowledge, skills and competencies. These contributions lead us to consider the fit between an educational arrangement, its intended learners and its purposes.

Three considerations from these sources enter our analysis: how learner choice is organized (Bernacki et al., 2021), how participation relates to appropriate support (Dumont & Ready, 2023), and the social circumstances surrounding engagement with talent provision (Rasmussen & Lingard, 2018). We connect the opportunities offered to learners with the support available for using them and with learners' involvement in shaping them. Developmental arrangements can then be examined both for what they demand educationally and for the position learners hold within them. Appropriate challenge, usable opportunities and participation concern how development is supported. Outstanding attainment concerns the competencies achieved. Keeping the two apart gives learners' agency a place in the analysis alongside attainment.

5. CONCEPTUAL SYNTHESIS AND MOROCCAN CONTEXUAL RELEVANCE

5.1. Connecting purposes, provision and evidence

An educational arrangement can support a relevant learning outcome while leaving its wider contribution unresolved. The preceding sections show why these matters for Education 4.0: frameworks connect competencies, learning methods, technologies and infrastructure, yet finding about one component or outcome cannot establish the contribution of the whole arrangement to talent development. Our synthesis examines that contribution through the relationship between intended purposes, developmental provision and supporting evidence.

Table 1 sets out the judgments involved and their implications for the same analytical illustration, university-industry curriculum collaboration.

Table 1: Analytical dimensions and their application to university-industry curriculum collaboration in Education 4.0

Analytical dimension	Focus of analysis	Application to curriculum collaboration
Economic relevance	The work-related competencies targeted and the outcomes examined.	Distinguish the competencies targeted through curriculum partnerships and internships (Costa et al., 2022) from the competency outcomes associated with particular forms of collaboration (Borah et al., 2021).
Societal responsiveness	The collective needs informing educational priorities.	Examine whose needs shape curricular choices, distinguishing societal need from market demand (McCowan, 2016),

		while recognizing that economic purposes can also include public benefit (Labaree, 1997).
Individual opportunity	Learners involvement in their learning experiences and the support accompanying their opportunities.	Examine opportunities for learners to participate in shaping their learning experiences and the self-regulatory and socio-emotional support available to them, applying the perspective developed by Dumont and Ready (2023)
Talent attainment	The distinction between competency gains and outstanding, domain-specific attainment.	Interpret competency gains associated with collaboration (Borah et al., 2021) separately from evidence of outstanding attainment relative to learning or training peers, as specified in Gagné's (2015) definition of talent.
National organization of support	Connections between institutional provision, accessible resources and continuing developmental opportunities	Examine how a partnership relates to accessible support across developmental stages (Ziegler et al., 2025) and to the relationships among education, industry, leadership and individuals considered in national talent development (Muyia et al., 2018)

Note: Authors synthesize cited sources. The first three dimensions examine perspectives on educational purposes; the fourth clarifies the attainment claimed, and the fifth addresses the organization of support. All five contribute to the paper's single research question. University-industry curriculum collaboration serves as an analytical illustration; the table does not establish that any particular partnership fulfills these purposes or belongs to a coordinated national system.

Costa et al. (2022) locate curriculum modernisation and internships within their Education 4.0 proposal. Miranda et al.'s (2021) components specify the choices within such provision: the competencies prioritized, the learning methods, the role of technologies and the infrastructure supporting participation. Industry involvement alone does not make a partnership an Education 4.0 arrangement. In this illustration, Education 4.0 is the orientation through which those educational components are considered together. Bondin and Zammit's (2025) virtual learning factories provide a concrete example of technology-supported activity around production decisions. Its existence, however, establishes neither the justification of a curriculum's purposes nor a national developmental effect.

Borah et al. (2021) supply evidence about one contribution of teaching-focused collaboration: associations with graduates' competency scores, which differ across collaboration types and measured competencies. Read alongside Costa et al.'s proposal, these findings show why the form of provision and the outcome assessed must be specified. They can inform a judgment about learning relevant to work. By themselves, they cannot establish employment, justify the selection of curricular priorities or demonstrate outstanding attainment. This limitation is no reason to disregard competency evidence; it identifies the particular judgment to which that evidence contributes.

Distinguishing societal need from demand supported by purchasing power brings attention to whose needs inform educational provision (McCowan, 2016). Economic purposes can also serve public good (Labaree, 1997), while learners' participation in shaping their learning experiences needs to be considered alongside appropriate developmental support (Dumont & Ready, 2023). For curriculum collaboration, these perspectives lead us to examine responsiveness to work-related requirements, the representation of collective needs and learners' involvement in their education. In our synthesis, competency outcomes inform one part of this examination; the justification of priorities and the place of learners require separate consideration.

Educational means are not neutral in relation to the ends pursued (Biesta, 2007). For this reason, we interpret decisions about curriculum content, participation and support as part of how purposes take educational form. Whose needs are represented matters when an arrangement is designed, not only when its outcomes are discussed. Distinguishing purposes from provision allows us to examine how the two relate throughout the arrangement's design and interpretation.

Talent refers to outstanding, domain-specific attainment relative to learning or training peers (Gagné, 2015). A developmental perspective also situates learning within trajectories involving opportunities and support (Subotnik et al., 2011). Drawing on both accounts, we distinguish the developmental provision an arrangement offers from evidence that talent has been attained. Competency gains can be part of such trajectories without being equated with outstanding attainment. This interpretation keeps developmental opportunities relevant, while access to support remains separate from classification by attained performance.

At the national level, resource accessibility and connections across developmental stages become central to the organization of talent support (Ziegler et al., 2025). Education, industry, leadership and individual ownership also enter the account of national talent development (Muyia et al., 2018). These two perspectives take our analysis beyond the gains of a partnership's immediate participants, towards its relationship with accessible, continuing support. We treat this relationship as an object of examination, not as an assumed feature of the partnership. It gives the analysis of national contribution its focus: how institutional opportunities connect.

The resulting framework connects three levels of judgment: what learners attain, what institutions provide and how opportunities are organized across development. Its contribution is a bounded integration of existing perspectives, applied to Education 4.0. Important elements of this reasoning are already present in Brown and Tannock (2009), Muyia et al. (2018), Biesta (2007) and Ziegler et al. (2025). What the present application adds is to make explicit how these elements change the interpretation of one and the same arrangement. This allows us to state that economically relevant learning, socially justified purposes, learner participation and connected support require related but distinct grounds.

5.2. The Moroccan context and institutional arrangements

Article 3 of Loi-cadre n° 51-17 connects the acquisition of competencies to personal fulfilment, integration into working life and participation in national development (Loi-cadre n° 51-17, 2020, art. 3). Similarly, the Nouveau Modèle de Développement presents the strengthening of human capital as supporting equal opportunity, citizens' autonomy and the country's future competitiveness (Commission Spéciale sur le Modèle de Développement [CSMD], 2021). In these documents, economic contribution appears alongside individual and societal aspirations.

Within higher education, the development of graduates' capacities is presented as contributing to their emancipation and, through it, to that of society. The use of digital technology to advance the democratization of higher education is also identified as a challenge (Instance nationale d'évaluation auprès du Conseil supérieur de l'éducation, de la formation et de la recherche scientifique [INE], 2018). These two positions give digitalisation an educational and social purpose that goes beyond the introduction of technological tools.

The Education 4.0 methods proposed under the academic-excellence orientation of PACTE ESRI 2030 include distance education, peer learning, and alternating study and work-based training. The plan also links student flourishing with cultural activities, sport, associational participation and societal engagement (ministère de l'Enseignement supérieur, de la Recherche scientifique et de l'Innovation [MESRSI], n.d.). These proposals combine teaching arrangements with opportunities for participation beyond academic instruction. For our analysis, they show how some of the purposes expressed in policy are given a proposed educational form.

Interviews with recruiters reveal expectations for more adaptable and specialized education and training, organized in partnership with higher education institutions (Draissi et al., 2023). In the same study, professors' course adjustments are described as individual initiatives rather than formal changes to university curricula. We interpret this distinction as drawing attention to where responsiveness takes place: changes introduced by individual professors differ from changes embedded in institutional curricula. The findings concern the experiences examined in that study and do not constitute an assessment of PACTE ESRI 2030.

The Moroccan sources approach educational change from different positions. The law and the Nouveau Modèle de Développement set out its purposes, while PACTE ESRI 2030 proposes teaching methods and opportunities for student participation. The interviews reported by Draissi et al. (2023) describe recruiters' expectations and professors' adjustments to their courses. Considered side by side, these sources draw attention to how broad educational aims relate to decisions within institutions. In our interpretation, the distinction

between individual teaching initiatives and formal curriculum changes helps to clarify where those decisions take shape.

The Moroccan illustration therefore gives a concrete role to the distinction between purposes, provision and evidence. Policy documents help to identify what educational change is intended to serve and how it is proposed; the interview findings inform our understanding of particular institutional experiences. Examining these sources together directs attention to how educational ambitions take shape in learning arrangements and institutional practices, while keeping the scope of each source clear.

CONCLUSION

This article has examined how Education 4.0's contribution to national talent development can be considered through educational purposes, developmental provision and supporting evidence. The synthesis applies these dimensions to the analysis of the same arrangement. It distinguishes what provision is intended to serve, how it supports development and which conclusions its evidence warrants. Economic relevance, societal responsiveness and individuals' opportunities provide different grounds for these judgments. The national dimension, in turn, concerns accessible and connected support across developmental stages.

University-industry curriculum collaboration shows why this distinction is useful. Evidence of work-related competency gains can inform one judgment without settling whose needs shape the curriculum, how learners participate or whether support continues beyond the immediate opportunity. Nor do such gains alone establish the outstanding, domain-specific attainment used here to define talent. These distinctions preserve the value of evidence about learning and access, while limiting the developmental claims made on its basis.

The Moroccan illustration shows how policy purposes, proposed educational arrangements and situated accounts of curricular practice can enter this analysis without being treated as equivalent evidence. The contribution is an explicit framework for interpreting claims about Education 4.0 provision. It draws together existing perspectives and does not claim a new general theory of talent. Its scope is limited by purposive source selection, the heterogeneity of literature and the absence of empirical validation. Further research could examine the framework's usefulness within particular arrangements and investigate how their purposes, participation conditions and links to subsequent opportunities are negotiated in practice.

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REFERENCES

1. Bernacki, M. L., Greene, M. J., & Lobczowski, N. G. (2021). A systematic review of research on personalized learning: Personalized by whom, to what, how, and for what purpose(s)? *Educational Psychology Review, 33*(4), 1675–1715. https://doi.org/10.1007/s10648-021-09615-8

2. Biesta, G. (2007). Why "what works" won't work: Evidence-based practice and the democratic deficit in educational research. *Educational Theory, 57*(1), 1–22. https://doi.org/10.1111/j.1741-5446.2006.00241.x

3. Biesta, G. (2020). Risking ourselves in education: Qualification, socialization, and subjectification revisited. *Educational Theory, 70*(1), 89–104. https://doi.org/10.1111/edth.12411

4. Bondin, A., & Zammit, J. P. (2025). Education 4.0 for Industry 4.0: A mixed reality framework for workforce readiness in manufacturing. *Multimodal Technologies and Interaction, 9*(5), Article 43. https://doi.org/10.3390/mti9050043

5. Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution? Education 4.0, teaching and learning in the digital age. *Higher Education Pedagogies, 5*(1), 223–246. https://doi.org/10.1080/23752696.2020.1816847

6. Borah, D., Malik, K., & Massini, S. (2021). Teaching-focused university–industry collaborations: Determinants and impact on graduates' employability competencies. *Research Policy, 50*(3), Article 104172. https://doi.org/10.1016/j.respol.2020.104172

7. Brown, P., & Tannock, S. (2009). Education, meritocracy and the global war for talent. *Journal of Education Policy, 24*(4), 377–392. https://doi.org/10.1080/02680930802669938

8. Chituc, C.-M. (2021). A framework for Education 4.0 in digital education ecosystems. In L. M. Camarinha-Matos, X. Boucher, & H. Afsarmanesh (Eds.), *Smart and sustainable collaborative networks 4.0* (pp. 702–709). Springer. https://doi.org/10.1007/978-3-030-85969-5_66

9. Commission Spéciale sur le Modèle de Développement. (2021). *Le nouveau modèle de développement : Libérer les énergies et restaurer la confiance pour accélérer la marche vers le progrès et la prospérité pour tous* [The new development model: Releasing energies and restoring confidence to accelerate progress and prosperity for all]. https://social.gov.ma/wp-content/uploads/2021/11/Rapport_General.pdf

10. Costa, A. C. F., Santos, V. H. de M., & Oliveira, O. J. de. (2022). Towards the revolution and democratization of education: A framework to overcome challenges and explore opportunities through Industry 4.0. *Informatics in Education, 21*(1), 1–32. https://doi.org/10.15388/infedu.2022.01

11. Costan, E., Gonzales, G., Gonzales, R., Enriquez, L., Costan, F., Suladay, D., Atibing, N. M., Aro, J. L., Evangelista, S. S., Maturan, F., Selerio, E., Jr., & Ocampo, L. (2021). Education 4.0 in developing economies: A systematic literature review of implementation barriers and future research agenda. *Sustainability, 13*(22), Article 12763. https://doi.org/10.3390/su132212763

12. Dean, J. (2026). The enabling role of digital competencies in heutagogical learning contexts: A hermeneutic phenomenological study. *Irish Journal of Academic Practice, 14*(1), Article 9. https://doi.org/10.21427/be8g-hq28

13. Draissi, Z., Rong, Y., & Ebrahim Suliman, M. A. (2023). Employability and education mismatch in the Moroccan urban workplace. *SAGE Open, 13*(4), Article 21582440231217890. https://doi.org/10.1177/21582440231217890

14. Dumont, H., & Ready, D. D. (2023). On the promise of personalized learning for educational equity. *npj Science of Learning, 8(1)*, Article 26. https://doi.org/10.1038/s41539-023-00174-x

15. Fataar, A. (2020). The emergence of an education policy dispositif in South Africa: An analysis of educational discourses associated with the fourth industrial revolution. *Journal of Education*, (80), 5–24. https://doi.org/10.17159/2520-9868/i80a01

16. Gagné, F. (2015). Academic talent development programs: A best practices model. *Asia Pacific Education Review, 16*(2), 281–295. https://doi.org/10.1007/s12564-015-9366-9

17. Gallardo-Gallardo, E., Dries, N., & González-Cruz, T. F. (2013). What is the meaning of 'talent' in the world of work? *Human Resource Management Review, 23*(4), 290–300. https://doi.org/10.1016/j.hrmr.2013.05.002

18. González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: Systematic review. *Sustainability, 14*(3), Article 1493. https://doi.org/10.3390/su14031493

19. Himmetoglu, B., Aydug, D., & Bayrak, C. (2020). Education 4.0: Defining the teacher, the student, and the school manager aspects of the revolution. *Turkish Online Journal of Distance Education, 21*(Special Issue-IODL), 12–28. https://doi.org/10.17718/tojde.770896

20. Instance nationale d'évaluation auprès du Conseil supérieur de l'éducation, de la formation et de la recherche scientifique. (2018). *L'enseignement supérieur au Maroc : Efficacité, efficience et défis du système universitaire à accès ouvert* [Higher education in Morocco : Effectiveness, efficiency and challenges of the open-access university system]. Conseil supérieur de l'éducation, de la formation et de la recherche scientifique.

21. Jaakkola, E. (2020). Designing conceptual articles: Four approaches. *AMS Review, 10*(1–2), 18–26. https://doi.org/10.1007/s13162-020-00161-0

22. Juvonen, S., Huilla, H., Kosunen, S., Thrupp, M., & Toom, A. (2024). Conceptualizing socialization, qualification, and subjectification as purposes of education. *Educational Theory, 74*(3), 389–410. https://doi.org/10.1111/edth.12652

23. Katz, V. S., Jordan, A. B., & Ognyanova, K. (2025). Digital inequalities and U.S. undergraduate outcomes over the first two years of the COVID-19 pandemic. *PLOS ONE, 20*(3), Article e0319000. https://doi.org/10.1371/journal.pone.0319000

24. Khupe, D., Zlotnikova, I., & Hlomani, H. (2026). Advancing technology-enhanced learning: A systematic literature review of innovative frameworks and emerging technologies for Education 4.0. *Journal of Teaching and Learning, 20*(1), 152–184. https://doi.org/10.22329/jtl.v19i3.9455

25. Labaree, D. F. (1997). Public goods, private goods: The American struggle over educational goals. *American Educational Research Journal, 34*(1), 39–81. https://doi.org/10.3102/00028312034001039

26. Loi-cadre n° 51-17 relative au système d'éducation, de formation et de recherche scientifique [Framework Law No. 51-17 on the education, training and scientific research system], Bulletin officiel n° 6944, 1967 (2020) (Morocco). https://www.sgg.gov.ma/Portals/0/BO/2020/BO_6944_Fr.pdf

27. Marginson, S. (2019). Limitations of human capital theory. *Studies in Higher Education, 44*(2), 287–301. https://doi.org/10.1080/03075079.2017.1359823

28. McCowan, T. (2016). Universities and the post-2015 development agenda: An analytical framework. *Higher Education, 72*(4), 505–523. https://doi.org/10.1007/s10734-016-0035-7

29. McGrath, S., & Powell, L. (2016). Skills for sustainable development: Transforming vocational education and training beyond 2015. *International Journal of Educational Development, 50*, 12–19. https://doi.org/10.1016/j.ijedudev.2016.05.006

30. Ministère de l'Enseignement supérieur, de la Recherche scientifique et de l'Innovation. (n.d.). *Le plan d'accélération de la transformation de l'écosystème de l'ESRI (PACTE ESRI-2030) : Architecture stratégique* [Plan to accelerate the transformation of the higher education, scientific research and innovation ecosystem: Strategic architecture]. https://www.uae.ac.ma/sites/default/files/2023-03/architecture-strategique-pacte-.pdf

31. Miranda, J., Navarrete, C., Noguez, J., Molina-Espinosa, J.-M., Ramírez-Montoya, M.-S., Navarro-Tuch, S. A., Bustamante-Bello, M.-R., Rosas-Fernández, J.-B., & Molina, A. (2021). The core components of Education 4.0 in higher education: Three case studies in engineering education. *Computers & Electrical Engineering, 93*, Article 107278. https://doi.org/10.1016/j.compeleceng.2021.107278

32. Muyia, M. H., Wekullo, C. S., & Nafukho, F. M. (2018). Talent development in emerging economies through learning and development capacity building. *Advances in Developing Human Resources, 20*(4), 498–516. https://doi.org/10.1177/1523422318803089

33. Rasmussen, A., & Lingard, B. (2018). Excellence in education policies: Catering to the needs of gifted and talented or those of self-interest? *European Educational Research Journal, 17*(6), 877–897. https://doi.org/10.1177/1474904118771466

34. Rienties, B., Ferguson, R., Gonda, D., Hajdin, G., Herodotou, C., Iniesto, F., Llorens Garcia, A., Muccini, H., Sargent, J., Virkus, S., & Isidori, M. V. (2023). Education 4.0 in higher education and computer science: A systematic review. *Computer Applications in Engineering Education, 31*(5), 1339–1357. https://doi.org/10.1002/cae.22643

35. Robeyns, I. (2006). Three models of education: Rights, capabilities and human capital. *Theory and Research in Education, 4*(1), 69–84. https://doi.org/10.1177/1477878506060683

36. Saniuk, S., Caganova, D., & Saniuk, A. (2023). Knowledge and skills of industrial employees and managerial staff for the Industry 4.0 implementation. *Mobile Networks and Applications, 28*(1), 220–230. https://doi.org/10.1007/s11036-021-01788-4

37. Schultz, T. W. (1961). Investment in human capital. *The American Economic Review, 51*(1), 1–17. https://www.jstor.org/stable/1818907

38. Souza, A. S. C. de, & Debs, L. (2024). Concepts, innovative technologies, learning approaches and trend topics in Education 4.0: A scoping literature review. *Social Sciences & Humanities Open, 9*, Article 100902. https://doi.org/10.1016/j.ssaho.2024.100902

39. Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education: A proposed direction forward based on psychological science. *Psychological Science in the Public Interest, 12*(1), 3–54. https://doi.org/10.1177/1529100611418056

40. Tan, E. (2014). Human capital theory: A holistic criticism. *Review of Educational Research, 84*(3), 411–445. https://doi.org/10.3102/0034654314532696

41. Wedekind, V., Russon, J.-A., Ramsarup, P., Monk, D., Metelerkamp, L., & McGrath, S. (2021). Conceptualising regional skills ecosystems: Reflections on four African cases. *International Journal of Training and Development, 25*(4), 347–362. https://doi.org/10.1111/ijtd.12251

42. Wilson, R. (2013). Skills anticipation—The future of work and education. *International Journal of Educational Research, 61*, 101–110. https://doi.org/10.1016/j.ijer.2013.03.013

43. Ziegler, A., Naujoks-Schober, N., Vialle, W., & Stoeger, H. (2025). Analyzing national talent support systems: The case for a resource-oriented approach. *Sustainability, 17*(13), Article 5896. https://doi.org/10.3390/su17135896