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Digital Intelligence Technologies and Curriculum Development in Higher Education: Implications for Sustainable Education

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Abstract

The swift progression of artificial intelligence (AI) has generated a necessary requirement for higher education organizations to implement Digital Intelligence Technologies (DIT) within their curricula. Previous studies have discussed AI in education, but few have observed how DIT improves curriculum development (CD) through teachers' beliefs in AI (TBAI), student engagement (SE), and technology trust (TT). Our study explores this gap within the art and design universities in Türkiye that are pursuing sustainability. Teacher education is necessary to equip them with sufficient knowledge to effectively incorporate DIT into current curricula. The study employs a quantitative methodology, utilizing a purposive sampling technique, and examines data from 250 students and teachers at three universities in Türkiye. The study sample comprised 148 students and 102 teachers. Responses from both groups were analyzed as a pooled sample to examine the hypothesized relationships, rather than to compare differences between the two groups. Data were collated through a structured survey. Structural equation modelling (SEM) was used to assess the data. This research examines the impact of technology-improved educational practices on curriculum development through engagement by the learner, pedagogical ideology, and beliefs in AI-supported educational processes. The study's findings demonstrate that incorporating DIT positively affects curriculum development, particularly when students engage at a high level and teachers' beliefs about AI are favorable. Technology trust also intensifies this effect. These findings provide empirical evidence for the integration of AI and curriculum development to attain sustainable education. Therefore, the study offers guidance to improve educational quality in higher education by examining the roles of teacher beliefs, student engagement, and technology trust in order to support Sustainable Development Goal 4 (SDG 4). The findings offer new insights into educational technology, instructional design, curriculum improvement, and teacher education, and support policies and practices that align curricula with international accreditation standards.

Keywords: digital intelligence technology; curriculum development; teachers' beliefs; student engagement; technology trust; SDG4

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1. Introduction

The exponential expansion of artificial intelligence (AI) is rapidly changing how we live, learn, and work. Progress in technology is motivating meaningful transformations throughout the higher-education sector; as a result, significant changes are being experienced. Thus, artificial intelligence is being implemented via data transformation through

design, evaluation, and improved curricula [1]. The prospect of implementing AI within education is widely considered for worldwide educational facilities that focus on its capability to transform learning, teaching, and institutional procedures. AI-driven tools and processes, incorporating generative AI systems, have transformed higher education by providing data-focused decision-making, adaptive evaluations, and tailored educational experiences [2].

Art is also not immune to the implementation of IT, more specifically, AI [3]. For example, robotics is used in the creation of paintings [4,5] and in the design of products [6,7]. Equipment like image creators and conversational AI is able to help students in picturing complex impressions, investigating through differing compositional procedures, and achieving immediate feedback. This kind of integration of technology can improve creativity, generate individual learning skills, and provide for students in a digital-focused art industry [2]. To meet the requirement to prepare students for the new technology era, there is an emerging focus on including AI education in the curricula to better equip the future generation to ensure they are capable of understanding the technology and skills needed to succeed in the AI–driven environment [8,9]. The term curriculum signifies all the planned exercises and experiences to be guided by the teachers and studied by the pupils, whether conducted in the classroom or outside. This research examines how AI impacts curriculum development within the setting of art and design education in Türkiye. Education, more specifically teacher education, has become more and more vital in Türkiye since the founding of the Republic. Türkiye's Higher Education Council (HEC) has established the necessary requirements for the advancement of teachers and the relevant criteria for degrees at universities. For faculties and graduate establishments, it further outlines the procedure and structure for teacher education programs, which in turn controls the teacher qualification process [10].

At the same time, previous papers have explored the connection between digital technology and the development of curricula [11,12], there remain limited studies exploring the role of student engagement and the teachers' viewpoints relating to AI in this specific relationship. This research appreciably expands the existing literature by focusing on the gap highlighted by Wang et al. [12], who stressed that there was a requirement for further research on the topic and that it should include further variables like teachers' beliefs concerning AI in education, trust in technology, and impact in classrooms. Furthermore, Zawacki-Richter et al. [13] highlighted fragile connections concerning research relating to AI applications in higher education and pedagogical concepts, together with restricted interaction of educators. Recently, Bond et al. [14] suggested that it was necessary to pay greater contextual attention to interdisciplinary methods in AI research in higher education. Research on pupils' commitment offers a harmonizing proposal: Bond et al. [15] documented significant variations in the conceptualization and theoretical basis of engagement relating to educational technology. Also, Nazaretsky et al. [16] indicated the importance of teachers' comprehension, together with trust in AI-powered educational technologies; however, their research involved professional development amongst K-12 science teachers. Teachers' opinions regarding AI have been included in this model as they are considered a vital factor for teachers to incorporate a number of technologies into the educational field [17]. Student engagement in this relationship was examined in research carried out by Wang et al. [12]. By examining the mediating roles of teachers' opinions/beliefs regarding AI, plus student engagement, together with the moderating role of technology trust, this study offers a further comprehension of the provisions required for efficient curriculum design. Furthermore, the research adds to educational technology studies by clarifying how AI-supported education environments can boost curriculum growth, teacher education and accreditation, and targeted curriculum development in the context of higher education.

It is important to understand that art and design education is based on a different set of principles than other types of education. In other subjects, digital technology is mostly used to give students information, to test their knowledge, or to assess their work. But in art and design education, the focus is on creative exploration, idea generation, visualisation, and experimentation [2,3]. Moreover, this study provides evidence to integrate AI-supported curriculum development and teacher education to advance the quality of higher education under Sustainable Development Goal 4 (SDG 4).

The main purpose of this study is to explore how Digital Intelligence Technology (DIT) improves curriculum development (CD) in art and design universities in Türkiye, with a specific focus on the mechanisms that allow teachers' beliefs regarding AI and Student engagement to mediate the relationship and how technology trust moderates it (See Figure 1). The research aims to contribute to the increasing body of literature on the topic of AI integration in universities by offering empirical evidence and theoretical insights based on the Technology Acceptance Model (TAM), Self-Determination Theory (SDT), and Educational Ecosystem Theory (EET).

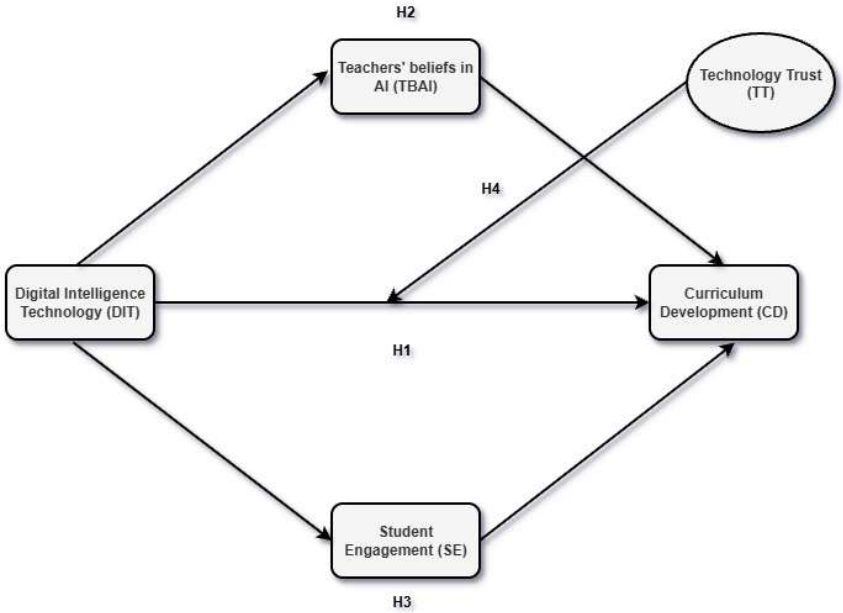

Figure 1. Conceptual Model.

2. Theoretical Background and Hypothesis Development

This study applies the Technology Acceptance Model (TAM), Self-Determination Theory (SDT), and the Educational Ecosystem Theory (EET) to systematically examine how DIT affects the efficiency of curricula at art and design universities. Davis [18] asserts that the most commonly employed model in the realm of technology is the TAM. When individuals are exposed to new technology, the model suggests that several factors influence their decision on the best way and time to apply it. Perceived usefulness (PU) and perceived ease of use (PEOU) are two key factors of TAM that predict the intention of users to make use of a technology, which in turn influences the likelihood of system use as a measure of system success [19].

Ryan [20] categorizes different intrinsic and extrinsic motivational elements within SDT. They suggest that everyone has three fundamental psychological needs: relatedness (feeling loved and connected), competence (feeling capable and proficient), and autonomy (feeling in control and having choices). Meeting these fundamental requirements can foster a superior form of motivation that enhances participation and perseverance in

pursuits [21]. Additionally, according to the concept of Educational Ecosystem Theory, DIT reorganizes learning environments and reallocates resources, thereby enhancing the overall educational setting. In accordance with the Educational Ecosystem Theory, the utilization of Digital Intelligence Technology (DIT) transforms the framework of learning environments by reallocating resources for education and interactions between students, teachers, and technology, creating a more responsive and adaptable educational ecosystem [12].

Consistent with TAM [22], perceptions of usefulness (PU) and perceived ease of use (PEU) considerably impact technology implementation [12]. This theoretical analysis supports H1, signifying that when teachers and students consider DIT as helpful and simple to apply, it directly and positively impacts curriculum development. At the same time, Self-Determination Theory (SDT) theorizes that technologies that generate autonomy, relatedness, and competence can build inherent motivation and engagement [21]. These motivational mechanisms describe how teachers' beliefs and engagement mediate the link connecting DIT and CD. As a result, H2 suggests that teachers' beliefs in relation to AI mediate the interaction between DIT and CD. From the viewpoint of SDT, these suggestions represent autonomous motivation—meaning educators who consider AI as developing their autonomy, competence, and relatedness are more fundamentally empowered to utilize it effectively in the curricula. Also, H3 falls in line with SDT by suggesting that student engagement acts as a motivational mediator, meaning students who understand autonomy and competence by using interactive AI technologies show better learning involvement, subsequently leading to improved curriculum results. Additionally, within the framework of Educational Ecosystem Theory, Digital Intelligence Technology redistributes resources and reshapes learning environments, theoretically enhancing the wider educational environment [12]. Extending the ecological perspective to educational technology, Zhao and Frank [23] hypothesized technology integration in schools as a process that is affected by communication among teachers and technological innovations. In accordance with EET, H4 proposes that when teachers and pupils consider AI systems as reliable and dependable in their educational ecosystem, the institutional environment develops into one that is more conducive to technology-focused efficiency.

Jointly, the implementation of TAM, SDT, and EET highlights that technological cognition, motivational engagement, and contextual trust and alignment interrelate to describe how DIT contributes to curriculum development at cognitive, behavioral, and systemic levels. While TAM and SDT individually clarify acceptability and motivation, they fail to explain the contextual interaction between individuals and institutional settings satisfactorily. The integration of EET provides a multi-faceted descriptive structure, linking individual approval (TAM), intrinsic motivation (SDT), and systemic alignment (EET) to achieve curriculum development.

2.1. The Role of DIT in Curriculum Development

Davis [22] developed the technology acceptance model (TAM), which is now a commonly used framework for evaluating how users determine which technologies to embrace or reject. Consistent with Davis [22], a person's decision to adopt or reject a technology is significantly influenced by the two core components of TAM: perceived usefulness (PU) and perceived ease of use (PEOU). PU is the idea that technology will help people do their jobs more effectively, and PEOU implies that it is simple to use and user-friendly [22]. A framework for smart education was presented by Wang et al. [12], which suggests a methodical way to include smart technologies into curriculum design. In addition to being compatible with the vibrant landscape of information systems education, the framework can assist students in completing the course material in accordance with their personal preferences for learning and habits. In order to prepare students for learning about these cutting-edge

technologies, a number of educators and education authorities have started considering incorporating AI subjects into curricula. Curriculum preparation is an inevitable part of such projects. The development of curriculum theories and teacher preparation would benefit from a comprehension of how current theoretical models of curriculum planning and teachers' perspectives can be applied to respond to the situation, given that AI is an area that is changing rapidly and that teachers are probably unfamiliar with its content [21]. The most crucial objectives for improvement are thought to be improving the clarity of concepts, creating a feedback mechanism, adopting and developing technologies, customizing the learning path, and adjusting the course frequently. These objectives serve as the foundation for creative curriculum design that addresses the survey's issues and eventually creates a new curriculum framework [12]. Within the context of educational technology and instructional design, AI-assisted Digital Intelligence Technology (DIT) has further been seen as a process to develop technology-improved learning environments that expedite adaptive teaching, interactive educational encounters, and personalized support in education [24]. By analyzing each student's weaknesses and strengths, customized instruction can be provided, and the curriculum can be adjusted accordingly [25]. In order to meet the requirements of the modern world, curricula must be continuously modified. AI is able to track the curriculum's effectiveness and pinpoint particular topics. In response to the need for more computer scientists and for citizens to have a better understanding of computer science, various countries have recently modernized their computer science curricula [26]. However, curricula will need to change more to cope with the growing interest in computer science, driven by machine learning and artificial intelligence. Some countries appear to be implementing curriculum initiatives in response to advancements in artificial intelligence [26]. Artificial intelligence (AI) is predicted to transform professional development and vocational education in lifelong learning. Training platforms with AI capabilities will be able to streamline the creation of flexible curricula, modifying the content based on each individual's development [27]. In addition to current trends, combining both instruction and entertainment has been shown to be a successful strategy for encouraging students to comprehend scientific subjects more effectively [28]. Therefore, we hypothesized that:

Hypothesis 1. *Digital Intelligence Technology directly and positively affects Curriculum development among art and design faculties in Türkiye.*

2.2. Teachers' Beliefs About Artificial Intelligence as a Mediator

People's beliefs are assumed to have a substantial influence on how they behave [29,30]. They are crucial factors that determine their behavior because they affect their intentions, attitudes, and actual performance in specific actions [17]. Several studies have shown that teachers' pedagogical beliefs influence how they incorporate and modify technology in their educational environment [31–33]. According to Choi et al. [17], teachers' beliefs that support from organizations and policies are acknowledged as crucial variables that impact educational setting behavior. Many studies have attempted to link teachers' beliefs and classroom behavior, examining a variety of categories of these beliefs [17], such as perceived complexity and usability [34], sociocultural factors [35], technology readiness [36], and pedagogical beliefs and practices [37] concerning their use of technology in a learning environment [38]. Researchers who attempted to integrate instructors' pedagogical principles with TAM discovered that they were a helpful alternative [17]. Many forms of attitudes of teachers about the use of technology in the classroom were covered in earlier research, including epistemological beliefs [31], pedagogical beliefs [39], and self-efficacy beliefs [40]. In this research, opinions about Digital Intelligence Technology (DIT) directly refer to teachers' pedagogical and technological opinions in reference to the application, simplicity of

use, and educational impact of DIT in the design of the curriculum and application within the classroom.

In the scope of education, teachers' opinions, organizational assistance, and strategies are understandably crucial aspects that impact the classroom environment [38]. Within this circumstance, teachers' positive beliefs regarding DIT heighten the integration of technology within the classroom, therefore improving curriculum development. The Theory of Planned Behavior offers additional theories relating to the proposed role of educators' beliefs [30]. Within the TPB, beliefs concerning behavioral outcomes enlighten attitudes, thereby further the intentions and behaviors together with subjective ideas and considered interaction control.

Thus, we propose:

Hypothesis 2. *Teachers' Beliefs toward Digital Intelligence Technology mediate the association between Digital Intelligence Technology and Curriculum development among art and design faculties in Türkiye.*

2.3. Student Engagement as a Mediator

With the help of AI, learning experiences may be tailored to each student's unique requirements and skills. Adaptive learning algorithms can help achieve this by modifying the speed of learning material and content based on the progress of the students. Better outcomes can result from students remaining interested in the subject matter, attributed to personalized learning [41]. Consequently, there is a chance that artificial intelligence will boost student engagement in learning. Given that every student learns differently and at a different pace, teachers who are aware of this fact frequently employ artificial intelligence in the educational setting [42]. Effective teaching and learning experiences depend on student engagement, which plays a crucial role in the educational field. Research suggests that students who are actively involved are more likely to recognize their potential for learning [43]. Compared to a human instructor, an AI-generated virtual instructor has a comparable positive impact on academic achievement and cognitive load while also greatly increasing affective involvement. Moreover, the conversational teaching approach lowers cognitive load, increases engagement, and significantly enhances students' academic performance [43]. This result is in line with findings that the use of AI tools, including adaptive learning systems, improves students' engagement, problem-solving abilities, and general academic performance [43]. Teachers can maximize students' comprehension and engagement by tailoring their teaching strategies to meet their unique requirements with the use of AI tools [44]. However, teachers may face a significant problem in achieving and sustaining high levels of engagement among students [45]. There are issues in integrating AI systems into the curriculum. Although AI can improve learning, educators are concerned that excessive use of the technology might diminish the interaction between humans that is necessary for good teaching and learning, or even restrict a student's capacity for self-reflection and self-evaluation due to a lack of AI-assisted education [46]. Furthermore, biases already present in education may be reinforced by insufficient training on AI use. To guarantee that AI enhances rather than diminishes the learning process, educators must successfully employ it [46]. The results show that DIT greatly improves student engagement and educational efficiency, both of which lead to better curriculum design outcomes. The importance of interactive learning in political and ideological instruction was highlighted by the fact that student engagement explained a larger percentage of the variance than teaching efficiency [12]. By using Digital Intelligence Technology (DIT), students' active involvement is heightened, resulting in higher interaction and cognitive development through offering adaptive and interactive educational practices. This increased engagement generates a

more comprehensive understanding, creativity, and problem-solving skills, which lead to improved learning results and reinforce the overall impact of the curriculum. Thus, we hypothesize:

Hypothesis 3. *A Higher level of student engagement mediates the link between Digital Intelligence Technology and curriculum development among art and design faculties in Türkiye.*

2.4. The Role of Technology Trust

Teachers can better fulfill the requirements of their students by creating an engaging learning environment with the aid of digital platforms. Teachers can use AI-based technologies to monitor student performance, deliver content, and offer assistance as needed [47]. For teachers, AI is a relatively novel concept. Teachers may therefore know very little or nothing about incorporating AI into their method of instruction because they are mostly digital immigrants. Some people may even be intimidated by technology, particularly artificial intelligence (AI), and may be hesitant to trust AI systems [48,49]. Thus, AI literacy and GenAI trust are closely associated. Teachers who possess a thorough understanding of artificial intelligence are more inclined to have trust in the technology's dependability and efficiency in learning environments [50]. When teachers perceive that a tool can actually enhance teaching or learning, they are more likely to adopt it. That is, usability by itself is insufficient. When simplicity bolsters utility, and the possibility of adoption rises, educators must also perceive a certain advantage [51]. Teachers' perceptions of AI-based systems are significantly influenced by trust [52]. Consistent with Asan et al. [53], an important determinant of choosing to accept new technology is technology trust. Since technology trust essentially involves risk and uncertainty, it is seen as even more important. The nature of AI has a significant impact on users' perceived trust (PT), which ultimately leads to a lower acceptance rate [17]. Students' learning experiences and results are greatly impacted by their level of trust in their capacity to use AI tools. A number of factors, such as perceived utility, usability, and confidence in AI technologies, influence this self-efficacy [43]. Furthermore, the most important elements affecting AI adoption in education were found to be trust in integrating AI tools, perceived usefulness, and ease of use. Similarly, Choi et al. [17] found that teachers' opinions regarding the use of chatbots as successful teaching tools were largely influenced by their usefulness and ease of use [54,55]. Trust enhances peer impact and influences how perceived efficiency models' users' willingness to integrate with technology [56]. Technology trust enhances or lessens the relationship between DIT and curriculum development, because those with increased trust are more likely to utilize AI systems appropriately and comprehend them to be beneficial for curriculum design. Therefore, we hypothesize that:

Hypothesis 4. *Technology Trust moderates the connection between Digital Intelligence Technology and Curriculum development among art and design faculties in Türkiye.*

3. Method

This chapter includes research design, Data Collection Tools, procedure, data analysis, ethical issues, measurement, and profile of participants.

3.1. Research Design

This research is designed on a quantitative research model using a cross-sectional design. Data were collated at a single point in time to explore the relationships amongst Digital Intelligence Technology (DIT), teachers' beliefs about AI (TBAI), student engagement (SE), technology trust (TT), and curriculum development (CD) in Art and Design universities in

Türkiye within two weeks. This research utilized a purposive sampling strategy to ascertain a variety of insights from teachers and students of three art and design universities in Türkiye. Goal-focused sampling was deemed appropriate as the research directly targeted applicants with explicit knowledge and involvement in AI-focused teaching technologies and digital learning within universities. This process was considered appropriate for this research as it permitted the inclusion of diverse respondents through differing departments and academic stages. The authors selected these institutions because they focus on integrating technological advancements with artistic fields in Istanbul, Ankara, and Izmir. The G*Power software v. 3.1.9.2 was used to estimate the required sample size for this research. To obtain a precise sample size calculation, an effect size (f2) = 0.1, an acceptable alpha ($\alpha = 0.01$), and a statistical power ($1 - \beta = 0.95$) were specified. Three predictors, the independent variables (DIT, TBAI, and SE), were identified in the study. Based on the G*Power analysis, a minimum of 233 were needed to accomplish suitable statistical power; as a result, 400 questionnaires were circulated through three universities. Through data screening and the elimination of incomplete responses, a total of 250 acceptable questionnaires were retained for further analysis. Approximately 250 of the 400 responses (62.5% of the total) were considered appropriate for further examination. The survey questionnaire had three main sections and was distributed online.

3.2. Data Collection Tools

The primary data collection tool of the study is a questionnaire. The first section of the questionnaire includes a cover letter outlining the study's goal and implications. The second section concerns demographic data, while the third concerns the survey questions. The e-distribution technique is used to collect data from 3 universities in Türkiye. According to Li et al. [57], the online questionnaire approach was selected because of its benefits, which include time and cost savings, rapid response, ease of response from any location, and the ability to collect a large amount of data in a shorter amount of time. Before the main data collection, a pilot test was conducted with a group of students to assess the clarity, comprehensibility, and contextual appropriateness of the Turkish questionnaire.

3.3. Procedure and Data Analysis

PLS SEM was selected for the prediction-oriented objective of the study, and it can evaluate formative and reflective constructs at the same time and is more efficient than covariance-based SEM [58]. Before analysis, the data were assessed for missing values and outliers, and the missing data were addressed through mean substitution; no relevant outliers were discovered. Initially, the outer model was evaluated, and validity and reliability tests were conducted for the reflective variables. The multicollinearity among the formative constructs was evaluated using variance inflation factors (VIFs) [59]. Additionally, to ensure data integrity, standard method bias was assessed. In the second stage, the structural model was evaluated by applying criteria such as path coefficients, significance, and collinearity, including the mediating role of two variables. Third, the authors examined the interaction effect of technology trust.

3.4. Measurement

This study used a survey questionnaire developed from previous studies to evaluate the proposed model (See Table S6). Karacaoglu [60] developed a 28-item scale to measure curriculum development (CD). This covered the design of curriculum, instructional processes, organization, and evaluation arrangement (for example, "Are the objectives clearly defined?" "Were educational tools and technology utilized to a relevant level?" "Was the physical environment suitable?") This curriculum evaluation questionnaire is a formative

instrument designed to capture participants' opinions and is used as a reliable and valid measurement tool. Our objective was to appraise the current curriculum to highlight the areas that require development. Digital intelligence technology (DIT) is evaluated using a 9-item scale designed by Igbaria et al. [61]. It demonstrates the perceived usefulness (for example, "By using digital intelligence, my job accomplishments were enhanced", "I have found that my work is improved by digital intelligence") and the relevant ease of use (e.g., "by understanding how to use digital intelligence, I found it easy to use"). Assefa et al. [62] evaluated student engagement using a 19-item measurement tool that which incorporates behavioral (like "I actively get involved in class discussion"), emotional (like "I feel proud of my educational results"), cognitive (like "I think innovatively and realize new suggestions in educational processes"), agentic (like "I make proposals to educators on how to enhance classes"), and socio-cultural dimensions (e.g., "I appreciate unity with my peers to allow respectful relationships"). The 10-item scale proposed by Ofosu-Ampong [38] is used to test participants' beliefs about AI (for example, "AI is an application for enhancing efficiency", "I consider that AI can improve learning results through interactive learning platforms," "AI tools could result in job displacement"). It focuses on safety, efficiency, and personalizing learning by using AI. Nazaretsky [52] designed a 6-item measurement tool to assess technology trust as a formative construct (Like, "The autonomy of AI-based tools offers me the opportunity to review their conclusions, then the greater chance I can trust them"; "I depend on the recommendation of AI-based tools to the same proportion as I trust the references from my teacher"). A 5-point Likert scale is used to rate each item from strongly agree to strongly disagree. The questionnaire was then translated into Turkish to ensure that the language and context were correct through the back-translation process.

3.5. Profile of Participants

The complete sample size comprised 250 contributors, containing 148 students (59.2%) and 102 teachers (40.8%) from three art and design universities in Türkiye. Students and teachers together completed the same survey, and no concepts were specified to either respondent group. This was designed to catch wider perspectives from both groups based upon AI-supported development, plus students' ideas of teachers' ideology regarding AI also the reverse, teachers' ideas on student engagement. Centered on the following demographic analysis of 250 people, 132 (52.6%) were male and 118 (47.4%) were female. The greatest age group, comprising 142 (56.6%) participants, was aged from 20 to 30 years, followed by 43 (17.1%) contributors aged from 30 to 40 years. A further 37 (14.7%) participants were under the age of 20, 18 (7.2%) were aged from 40 to 50 years, and 10 (4.4%) contributors were aged 50 or older (See Table S1).

3.6. Ethical Consideration

This research was carried out in full compliance with the ethical standards detailed in the Declaration of Helsinki [63]. This study posed minimal risk to participants. The data were collected anonymously via an online questionnaire, and no personal information was asked for; participants were allowed to withdraw from the survey at any time. The potential benefits of the research, such as improving curriculum design and supporting AI integration in higher education, may outweigh the minimal risk associated with the participants. Contributions were completely voluntary, and all participants were advised in regard to the purpose, scope, and confidentiality of the research prior to their participation. Informed consent was achieved digitally through an online questionnaire, which consisted of a cover letter detailing that all answers would remain anonymous and could only be used for academic purposes.

4. Result

4.1. Evaluation of the Reflective Measurement Model

Table 1 presents the reliability and validity assessment of three reflective variables: beliefs toward AI, Digital Intelligence Technology, and student engagement. All observed variables exceeded the recommended outer loading threshold of 0.708, although outer loadings higher than 0.5 are also acceptable [58], confirming their significance (See Table S2). Two engagement indicators from students with loadings lower than 0.70 were discounted during the measurement model refinement, allowing 17 indicators. Internal consistency reliability tests showed strong reliability for all variables, surpassing the 0.7 thresholds for Cronbach's alpha and composite reliability (CR) [58]. Convergent validity was evaluated by average variance extracted (AVE) values exceeding 0.5 for all variables.

Table 1. Reliability and validity assessment of reflective constructs.

Construct	Cronbach's Alpha	CR (rho_a)	CR (rho_c)	AVE
TBAI	0.916	0.917	0.930	0.570
DIT	0.922	0.923	0.936	0.617
SE	0.938	0.939	0.945	0.504

Note: TBAI = Teachers' beliefs in AI; DIT = Digital intelligence technology; SE = Student Engagement.

4.2. Evaluation of the Formative Measurement Model

The formative assessment model for curriculum development (CD) and technology trust (TT) is analyzed in Table S3, indicating that there are no multicollinearity problems because all indicators have appropriate outer weights and VIF values lower than the suggested threshold of 3.3. The findings show that all observed variables related to the two formative variables achieved this requirement.

4.3. Discriminant Validity Assessment

The HTMT ratio was applied to evaluate discriminant validity. All of the HTMT index values, as displayed in Table 2, are less than 0.9, demonstrating discriminant validity and the empirical distinction of each construct within the model.

Table 2. Discriminant validity.

	TBAI	CD	DIT	SE	TT	TT × DIT
TBAI						
DIT	0.708	0.802				
SE	0.561	0.742	0.771			

Note: TBAI = Teachers' beliefs in AI; DIT = Digital Intelligence Technology; SE = Student Engagement; CD = Curriculum development; TT = Technology Trust.

4.4. Model Fit

Model fit was analyzed with the Standardized Root Mean Square Residual (SRMR = 0.046), which fits in the acceptable range (SRMR < 0.08), thereby reaffirming a satisfactory model fit and predictive accuracy. (See Table S4).

4.5. Common Method Bias

Common method bias is assessed in PLS-SEM at the measurement phase, which affects the results. The collinearity test was developed by [64] to evaluate lateral and vertical collinearity at the same time. Variance inflation factors (VIFs) were generated for each latent variable by the automated process. The model is confirmed to be free from common

method bias (Table 3) because all VIFs from the whole collinearity test are 3.3 or less, guaranteeing more trustworthy PLS-SEM analysis results [64].

Table 3. Common method bias evaluation.

	TBAI	CD	DIT	SE	TT	TT × DIT
TBAI		1.773				
CD						
DIT	1.000	3.164		1.000		
SE		2.104				
TT		1.458				
TT × DIT		1.056				

Note: TBAI =Teachers' beliefs in AI; DIT = Digital Intelligence Technology; SE = Student Engagement; CD = Curriculum development; TT = Technology Trust.

4.6. Evaluation of the Structural Model

To safeguard strong parameter evaluations, the bootstrapping resampling process (5000 subsamples) was used with a 95% confidence interval. Table 4 and Figure 2 demonstrate the structural models' results, containing path coefficients (β), t-statistics, *p*-values, and 95% confidence intervals (CIs). Additionally, the standardized path coefficients (β) and effect sizes (f^2) were calculated to gauge the contribution strength of each predictor variable in relation to curriculum development. Correspondingly, [58], values of 0.02, 0.15, and 0.35 signify small, medium, and large effects, respectively. Reporting confidence intervals permits the measurement of the precision and strength of the approximate path coefficients. All confidence intervals do not include zero, substantiating that the hypothesized relationships are statistically significant and stable across resamples. The table also demonstrates the positive and direct effect of digital intelligence on curriculum development (β = 0.305, t-value = 4.588, $p < 0.01$). To assess statistical significance, the *p*-value and T-statistic must be used. Whether the *p*-value is less than 0.05 or 0.01, the effects are significant at the 95% and 99% levels, respectively [58]. The bootstrapping method by SmartPLS4 is used for assessing the mediating role of components in a model that was also proposed by Zhao et al. [65]. The H2 indirect effect from DIT to CD via TBAI shows a statistically significant relationship (β = 0.083, t-statistic = 2.725, and a $p < 0.01$). The H3 indirect effect from DIT to CD through SE (β= 0.223, t-value = 5.106, and $p < 0.01$) reveals that the indirect effect is significant. Consequently, H2 and H3 are supported. Moreover, the moderation effect of technology trust on the association between DIT and CD (H4) is also significant, with a β of 0.147 (t-value = 6.169, *p*-value = 0.000). Therefore, all hypotheses are accepted and significant. Furthermore, the results in Table 4 show that all VIF values are less than 3.3 for the inner model, indicating that multicollinearity is absent in this model [59].

Table 4. Hypothesis testing of the structural model.

H No.	Hypothesis Path	β	VIF	T-Statistic	*p*-Value	95% Confidence Interval (2.5–97.5%)	Result
H1	DIT → CD	0.305	3.164	4.588	0.000	[0.171–0.431]	Supported
H2	DIT → TBAI → CD	0.083	1.773	2.725	0.007	[0.025–0.146]	Supported
H3	DIT → SE → CD	0.223	2.104	5.106	0.000	[0.140–0.310]	Supported
H4	TT × DIT → CD	0.147	1.056	6.169	0.000	[0.094–0.189]	Supported

Note: TBAI = Teachers' beliefs in AI; DIT = Digital Intelligence Technology; SE = Student Engagement; CD = Curriculum development; TT = Technology Trust.

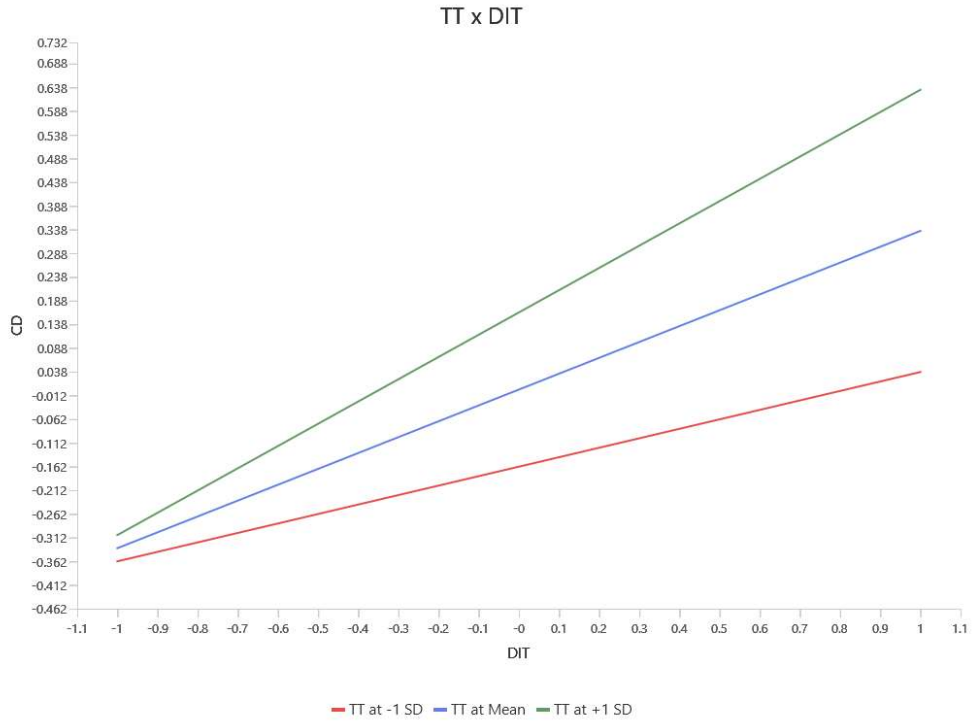

Figure 2. Simple Slope Analysis.

4.7. Explanatory Power of the Structural Model (R^2)

The model described 42.7% of the variance in teachers' beliefs regarding AI ($R^2 = 0.427$; adjusted $R^2 = 0.425$), 51.7% in student engagement ($R^2 = 0.517$; adjusted $R^2 = 0.515$), and 69.2% in curriculum development ($R^2 = 0.692$; adjusted $R^2 = 0.686$). These values highlight in-sample explanatory power and do not determine out-of-sample predictive performance (see Table S5).

4.8. The Assessment of the Moderator

Figure 2 demonstrates that technology trust (TT) significantly strengthens the positive relationship between Digital Intelligence Technology (DIT) and curriculum development (CD); specifically, as technology trust increases, the impact of DIT on CD becomes stronger. At high levels of TT (+1 SD), the effect of DIT on CD is most pronounced, while at low TT (−1 SD), the relationship remains positive but is considerably weaker. This indicates that technology trust intensifies the benefits of DIT on curriculum development, endorsing the existence of a significant moderation effect in the structural model.

5. Discussion

This research paper investigates the role of DIT and how it impacts the improvement and effectiveness of a curriculum within education in arts and design, and how the belief in AI by teachers can affect student engagement. The role of DIT as a standalone teaching aid will not necessarily develop the curriculum's effectiveness. This is potentially because these hi-tech tools occupy a supportive role as opposed to the main focus during the application of the curriculum design. Although, the positive direct relationship concerning DIT and CD ($\beta = 0.305$) supports H1, representing that DIT is positively associated with CD yet after accounting for the mediators and technology trust. Accordingly, the results recognize DIT as a relevant contributor to curriculum development.

As a result, these outcomes highlight the requirement to reinforce teachers' attitudes in encompassing modern technologies with curriculum subjects to increase the leverage

of technology within CD [12]. Therefore, teachers' beliefs in AI have been included in the model, as they are considered crucial for teachers to implement a variety of types of technology within the context of education [17]. Furthermore, the responses indicate that DIT considerably improves the engagement of students, which will inevitably lead to an improvement in curriculum development. Plus, trust is important in AI-based technology and is utilized by professionals [52]. Therefore, it is apparent from our research that improved technology trust strengthens the positive impact on curriculum development. Regardless of these positive results, the implementation of Digital Intelligence Technology (DIT) into universities comes with complications. Teachers' resistance to technology and restricted comprehension of AI can impede the adoption of new technologies, specifically among teachers who consider AI complex or are anxious that it could replace their educational authority [48,66]. In research on AI-assisted decision-making, Buçinca et al. [67] discovered that users would consider accepting invalid AI recommendations and that supporting deliberate evaluation lessened dependency. When applied to curriculum development, the results suggest that the importance of trust related to technical ability came together with critical evaluation. AI is able to offer critical approaches for curriculum development that match the ability of AI, together with the incorporation of data-based evaluations, flexible presentation of content, and instantaneous feedback capability [24]. By coordinating educational targets using AI, educational establishments can generate more inclusive, appealing, and progressive educational environments that offer students more opportunities to succeed in a rapidly developing digital world. Numerous educational technology devices, like adaptive educational facilities, smart teaching platforms, and diagnostic analytics, demonstrate clearly the capability to provide for different students' necessities and thereby improve academic accomplishment. This demonstrates the significance of instructional design choices in technology-driven learning establishments [24]. The present study highlights the quality of higher education through the development of an AI-supported curriculum, which leads to achieving Sustainable Development Goal 4 (SDG 4). This contribution could be explained as a potential pathway to achieve sustainable educational development, even though the study did not directly assess its progress with SDG indicators.

Based on TAM, SDT, and EET, this research clarifies curriculum development through a multi-dimensional theoretical viewpoint. TAM describes the cognitive dimension, highlighting that apparent usefulness and user-friendliness motivate students' and teachers' enthusiasm to adopt DIT. In TAM, educators' confidence in AI improves both the perceived implementation and considered user-friendliness, main points that focus their behavioral aim to integrate digital technologies with educational practices [17,18]. If teachers consider AI as advantageous and practicable, they are more likely to engage and redesign educational procedures, enhance assessment processes, and improve educational adaptation—all of which strengthen curriculum development. From the perspective of SDT [20]. These kinds of ideas achieve an intrinsic stimulating requirement for autonomy (the opportunity to experiment with AI tools), competence (aptitude to adapt to digital tools), and relatedness (interaction with students engaged with interactive AI tools).

5.1. Theoretical Implications

The implementation of artificial intelligence (AI) has accumulated a number of different innovations within education, integrating areas like curriculum enhancement, teaching practices, and assessment programs [68]. More recently, there has been growing impetus to include AI topics within the curricula of undergraduate, graduate, and faculty programs, more specifically, those that do not usually specialize in computer studies. AI programs are becoming more and more popular to immerse students in these areas as soon as possible [69]. Furthermore, AI can be adapted to assist teaching and research within curriculum

design and appraisal, together with a monitor to establish progress and highlight those students who require further assistance and support specifically [68,70]. Previous research highlighted that educators may resist the integration of innovative subjects if they are unable to observe the value of the implementation with regard to the support of their educational goals [9]. Teachers who feel more comfortable and have a sense of collectiveness are likely to embrace the risks of implementing AI and are willing to try new teaching processes and experiment with their lesson plans [71]. Therefore, it is apparent that when a teacher is less confident in their own skills or restricted by external factors, they could be less willing to try adapting or implementing new subjects within their teaching methods [72].

The existing results demonstrate alignment with and separation from past empirical studies, offering theoretical views into these models. In accordance with Wang et al. and Choi et al. [12,17], this paper reaffirms that teachers' educational beliefs are crucial in adapting digital technologies into curricula, with positive impacts, supporting the focal point of perceived usefulness and ease of use as suggested by TAM. Furthermore, the positive influence of student engagement on curricula [12] proposed that AI-supported education nurtures motivation and performance. In contrast, Slimi et al. and Erol & Erol [48,66] discovered that low AI literacy restricted the implementation of digital technologies by teachers. This current research noted a mediating impact of teachers' beliefs, proposing that creative arts teachers could have a more adaptable theoretical focus that values exploration and innovation. Additionally, a discrepancy arises in regard to technology trust. Whereas [52] emphasized students' wary attitudes toward AI autonomy, our data demonstrate that TT increases the link between DIT and curriculum development. This variance can be conceptually rationalized through EET, in that environmental support and combined standards moderate risk perception. The convergences and divergences together suggest that cultural standards, orientation to discipline, and ecosystem trust form the cognitive and stimulating structures through which DIT heightens curriculum development in art and design education. Based on Skalka et al. [73], male respondents and IT students consistently reported higher levels of readiness and satisfaction with AI than their respective comparison groups.

The Turkish Council for Higher Education (YOK) is convinced that the crucial factors required to enable university graduates for successful practices require assessment and a mechanism for evaluation, leading to an accreditation process and flexible financial and administrative decision-making powers [74]. Total Quality Assurance (TQA) was utilized to carry out an assessment across core subjects. One of the main core topics is the Curriculum Design Content Organization (CDCO) [75]. This establishes the exact content, design, and organization of the curriculum, which in turn is strictly assessed and classified in conjunction with the quality assessment program. AI-driven curricula improve the educational standard by integrating subject content along with assessment processes in line with internationally recognized standards, thereby creating consistent, dynamic, and relevant educational practices.

5.2. Practical Implications

Educational organizations should propose strategies that advance the incorporation of digital intelligence technologies in a form that is suitable for the teaching process and the student requirements, creating an achievable, balanced, and effective integration for the design of the curricula. Educators demonstrate notable alterations in instructional practices and digital literacy, demonstrating the requirement for schools to introduce current programs for training, offer technical support, and introduce mechanisms to incentivize teachers [12]. As a result, this research opens practical suggestions for teachers and policymakers alike. For pedagogical policymakers, the results highlight the critical significance

of aligning nationwide AI-in-education targets with digital implementation initiatives of the Turkish Ministry of National Education and the Council of Higher Education (YÖK) to safeguard educational awareness and quality assurance. For educators and designers of curricula, this research delivers evidence-based guidance for implementing DIT tools that can create and nurture student engagement and curricular efficiency in line with national higher education targets. Initially, it proposes that training programs for teaching staff must focus their attention on AI instruction, but must also demonstrate the positive effects of the use of AI. Next, the engineers in AI-based education programming should focus on preparing features that will directly help achieve better classroom efficiency and improve the quality of learning. Finally, educational organizations must ensure that the practicality of the tools is more valid than the novelty aspect and focus entirely on the effectiveness of supporting educational goals. These suggestions should overlap with the designers of the curricula and school technology sellers who wish to implement AI integration within educational establishments [51].

Educational technology creators and instructional designers must, as a result, focus on the generation of AI-supported systems which improve creativity, teamwork and instantaneous teacher support as opposed to just computerizing educational procedures. More specifically, AI-driven teaching technologies which are utilized in education must maintain the prospect for human creativity, insightful thinking and learning which encourages collaboration whilst at the same time supports adaptable curricula, teaching methods and personalized study conduits [76].

5.3. Limitations and Future Recommendations

In spite of these contributions, there remain several limitations that should be acknowledged. Firstly, the generalizability of our findings could be restricted by the overall cultural and educational contexts of the selected programs in Art and Design based in Turkish universities. We would recommend further studies in the future to duplicate our study in diverse settings, which should provide more detailed data reflecting the cultural factors on the efficiency of curricula. Secondly, this research relied on cross-sectional data, which may not capture the ever-changing nature of DIT evolution and its effects on efficiency. Future research should utilize a longitudinal design to explore how DIT impacts educational results over a period of time. Thirdly, the research we carried out focused on key variables like teacher beliefs, student engagement, and technology trust, plus other factors that have been overlooked in combining AI into education. Further research should examine additional variables: institutional resource allocation, training schemes for teachers, and course design. Fourthly, although this research adopted a quantitative research design employing structural equation modelling (SEM) to examine the proposed relationships, future studies can take advantage of using mixed-method approaches. By using a mixed-method system, it would permit future researchers to supplement the statistical data with interpretive depth and create a more holistic comprehension of DIT's impact on curriculum development. Fifthly, as the research is focused on self-reported information, there could be an opportunity for perceptual or social appeal bias in contributors' replies. It is suggested that future research integrate multiple data sources, including organizational and observational data, to corroborate self-reported measures and improve the strength of the results. Lastly, the implementation of indistinguishable items through teachers and students increases concerns regarding the constructs that have the same meanings across respondent roles. Measurement invariance and disparities in structural relationships were not measured, reducing the interpretability of collective estimates. Further studies could use clearly defined respondent perspectives and evaluate measurement equivalence prior to comparing or pooling groups.

6. Conclusions

Based on the Technology Acceptance Model (TAM), Self-Determination Theory (SDT), and Educational Ecosystem Theory, this research methodically investigates the mechanisms through which Digital Intelligence Technology (DIT) positively impacts the effectiveness of the curriculum within the three art and design universities in Türkiye. The outcome focuses on the relevance of integrating advanced digital tools into the curricula for educational purposes. Teachers' beliefs partially mediate between DIT and curriculum development, therefore indirectly recommending the integration of DIT into curriculum development. Furthermore, student interaction mediates the link between DIT and curriculum development via a variety of dimensions, such as emotional, behavioral, cognitive, and socio-cultural engagements. Moderation analysis revealed that trust significantly impacts the relationship linking DIT and curriculum development. This, in turn, indicates that higher levels of trust increase the positive results of DIT, emphasizing the requirement for educational establishments to generate an atmosphere of trust towards the integration of AI technologies.

These results offer notable implications for educational policies and practices alike, demonstrating that with the successful introduction of DIT into the curricula, efficiency depends on the dual role of enhancing teachers' belief in AI and student commitment. This demonstrates the requirement for instructional administrators to focus their design on technology-based training and a curriculum design strategy to improve trust amongst teachers and students alike, thereby optimizing the overall effect of achieving the objectives of the curriculum. From the aspect of educational technology, the results highlight that the efficiency of AI-generated instructional technologies is contingent not just on the accessibility of technology but further on the quality of instructional design, learner interaction plus pedagogical participation. The study therefore contributes to the empirical evaluation of AI in sustainable education by identifying and measuring variables that affect curriculum development. These findings can inform institutional efforts to advance Sustainable Development Goal 4 (SDG 4). The results provide evidence that higher education establishments could utilize when contemplating digitally supported curriculum development, with possible relevance to the quality dimension of SDG Target 4.3. Their influence on sustainable education continues as a proposed implication needing further development through educational quality, impartiality, proficiency, and sustainable indicators.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su182312021/s1. G*Power test, Table S1: Demographic information of the participants; Table S2: Outer loading; Table S3: Reliability and validity assessment of formative constructs; Table S4: Model Fit; Table S5: Explained variance of the endogenous constructs; Table S6: Questionnaire.

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