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The Enigma of the Ontological Foundations of AI, or Does AI Truly Think?

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Abstract

The primary question addressed in this research is whether AI processes information and reasons analogous to human cognition, specifically by operating with idealized representations of real-world objects. Is it possible to claim that the external world is somehow represented in AI's cognition and thus exists for it? Based on the analysis of the available material, our research shows that the AI models developed from 1950-1999 were based on the early view of ontological naturalism. The article proposes a philosophical concept of reality as a function of the social activity of humans as vulnerable bodily beings. It is shown that for AI, reality is deontologized by translation into the language of mathematical *meanings.* In addition, the article proposes methods for the potential ontologization of AI thinking, aiming to align its processes more closely with human thinking. The development of game intelligence in AI provides a path for AI thinking to interact with reality and become more similar to human intelligence. However, the article concludes that modern models of generative AI inherit the shortcomings of their predecessors, with their effectiveness, particularly in passing the Turing test, being attributed to the emerging access to the vast reservoir of human cultural experience — the Internet.

Keywords: ontology, being, social reality, thinking, AI, artificial intelligence, social practices, game

In the field of artificial intelligence (AI), prominent politicians and scientists of our era see a driving force comparable in transformative energy to historical inventions like the steam engine, electricity, and atomic energy. The possibility of mass access to the emerging generative AI model was described by the authors of *The Age of AI: And Our Human Future* by Kissinger, Schmidt, and Huttenlocher (2022) as "a philosophical and practical cry of such a scale that has not happened since the Enlightenment" (p. 21).

However, AI's expansive capabilities also give rise to new challenges unprecedented in history. In particular, machines' *intellectual* operations, the sources underlying their *inferences,* the ongoing phase of their *learning,* and the nature thereof remain largely opaque.

The intelligence of generative AI models is fundamentally different from human understanding. Human understanding of every situation has an existential meaning, i.e., it can be described in a subjective coordinate system as a particular intentional state that constitutes the ontological context (where and when the subject is), the modality of what is understood (as something accidental or inevitable) and a pragmatic attitude corresponding to ontology and modality. Thus, every act of understanding represents 1) a moment within the existence of reality (the lifeworld of an individual that is grounded in historical, cultural certainty) and 2) a moment

in the life of an individual (colored in emotional and socio-practical tones such as fear or admiration, responsibility or indifference). Thus, human reality encompasses the individual's body immersed in social space linked to the possibility of social action. Situations that contradict the biological and social security of the actor are either completely excluded from the human's reality or subject to strict censorship.

Nothing like this, at least for now, exists for AI. For AI, human reality is translated into the language of mathematical *meanings*, the totality of which is based on relevant initial data and conclusions but does not have a human dimension to connect them or, more precisely, has the character of a black box between these data and conclusions. Therefore, discussions about the responsibility and safety of AI activities can only be addressed in a preliminary manner, point by point.

At the same time, in *The Age of AI*, the authors highlight that machine learning systems are already surpassing the knowledge of any human. In some cases, they exceeded the knowledge of humankind, going beyond what we considered knowable. In the future, as machines increasingly rely on their own generated data for their conclusions, we should anticipate a widening gap between human knowledge and AI knowledge. Human reality, or *the world consisting of things*, is commensurate with human sensuality and corporeality, while *the world by itself* has, in all likelihood, an infinite number of aspects, and our reality is only one of an infinity of possible worlds. From this standpoint, the mathematical reality of AI is not a reality. As such, it is impossible to talk about any human-like (i.e., related primarily to the preservation of a certain appearance of the world) activity of AI. Attempting to do so would dangerously misapply the parameters of human activity and understanding, leading to the development of mathematical models without any ontological content.

A significant problem is deontologizing the reality that the human mind considers the *external world*: mathematical and physical representations of objects in the real world, with all their accuracy about individual parameters of things, schematize and simplify reality.

The language of mathematical dependencies with which AI only deals, although tied to the parameters of the relevant initial data and intended conclusions, does not have *a human dimension, and the thinking of AI, the intermediate moves of which are not known even to its developers, is similar to the* black box. Even if developers manage to *tie* AI to the qualitative and quantitative certainty of our world using sensory information, the image of reality that we are familiar with, outside of which a person cannot exist, will remain something random and potentially unnecessary for AI, which, undoubtedly, will pose a threat to humans and create risks for them.

Problem Statement

The widespread access to generative AI (GPT-4, Bard), which appeared in 2022-23, has elevated discussions about AI safety. In March 2023, a petition, signed by Elon Musk and Apple co-founder Stephen Wozniak, even appeared, advocating for a pause in developing artificial intelligence technologies until reliable security protocols are developed and implemented (Pause Giant AI Experiments: An Open Letter, 2023).

The most critical challenge in the coexistence of AI and humans lies in the difference between the paradigms of intelligence they employ. A person's perception and understanding of the surrounding world always has an existential dimension. A dimension is connected with the threats determined by the integrity of preserving one's own personality (for example, a person being accidentally hit by a car or a threat of a person losing their mind). Today's AI *builds* its conclusions based on the array of data sets it was trained on, which reflect human experience shared on the Internet and only indirectly correlates them with existential states. In this regard, it is difficult for AI to establish the existential limitations (of a physical, ethical, and social nature) that a person rarely loses sight of. Also, it is difficult to *teach* AI to bypass false or confusing initial data that is already added or will be entered into data sets used by generative models, for example, misinformation added on purpose by malicious actors and information that AI might interpret with discriminatory consequences (he Importance of International Norms in Artificial Intelligence Ethics).

As mentioned above, the issue is further aggravated by the fact that specialists in the field of AI often fail to recognize the problem of deontologizing reality for AI. Thus, they subconsciously incorporate rather simplistic ontological models into the principles of AI's functioning.

However, as the ancient Greek philosophers pointed out, all constructs of the mind—ideas about the good, the true, and the beautiful—directly depend on what is recognized as existing; that is, they depend on ontology[i], so it would be very short-sighted not to notice this problem.

Deontologization of reality as a problem of AI

In what is now considered a classic article, titled *Making a Mind Versus Modeling the Brain: Artificial Intelligence Back at a Branchpoint*, Dreyfus and Dreyfus (1988) begin to outline the history of AI from the early 1950s when two different theoretical approaches emerged. One approach saw computers as a system for manipulating mental symbols, and the other saw them as a medium for modeling the brain. Symbolic AI is a general name for technologies for modeling human thinking based on a symbolic image of sequential, logically related premises and conclusions.

The new research area's main principles and ideas were discussed at the so-called Dartmouth Summer Research Project on Artificial Intelligence, in the preparatory documents for which the term *artificial intelligence* was used for the first time as the name of a scientific discipline. Many AI pioneers participated in the project, including Herbert Simon, Allen Newell, Marvin Minsky, John McCarthy, and Claude Shannon. At this workshop, the main ideas of the two approaches described by the Dreyfus brothers were articulated. These two approaches are primarily associated with Newell and Simon's first tradition and Hebb and Rosenblatt's second tradition.

Newell and Simon developed the physical symbol system (PSSH) hypothesis, which states: "A physical symbol system has the necessary and sufficient means for general intelligent action" (Newell & Simon, 1976, p.117). Based on this hypothesis, intelligence is a mechanism

for manipulating symbols, and according to this perspective, a computer capable of manipulating symbols could be intelligent.

The hypothesis was developed as a summary of the work on the Logic Theorist program developed by Simon, Newell, and Shaw in 1955-1956. *Logic Theorist* (1956) demonstrated results akin to human reasoning—it remembered and processed information, made logical conclusions, and proved theorems, and is today considered one of the first artificial intelligence programs.

Today, researchers understand that, despite its impressive results, the *Logic Theorist* (Newell, Simon, & Shaw, 1956), with its symbolic model of thinking, remained nothing more than a model since the number of initial data, scenarios for their transformation, the results obtained, and further potential steps exceeded the horizon within which the transformations could still be processed by the machines that existed at that time. It became evident that neither the increasing computational power of computers nor the ingenious heuristics implemented by researchers to cut off the unpromising paths of machine reasoning could compensate for the inherent shortcomings of symbolic AI. In the case of artificial and significant limitations of symbolic objects, computers built by analogy with the Logic Theorist showed convincing results. However, their convergence with natural human intelligence never occurred.

The decline of the above-mentioned symbolic AI paradigm as a standalone project (although its developments remain relevant in various fields of computer science) is attributed not to an incorrect understanding of the algorithms of human reasoning but rather to an erroneous representation of the objects of thought and reality. If we can call it this way, the program's thinking assumes that it deals with homogeneous objects (specifically, their symbols) connected by relationships that lend themselves to logical formalization. In contrast, human thinking operates with the meanings of things (intuitively identifying the mental image of a thing with the thing itself). What is more, the structure of meaning initially includes a specific (and minimal) repertoire of ways and cases of legitimate use of meanings (concepts) and the things they denote. For instance, a modern human may not realize that he intuitively puts biological rather than mythological traits in the notion of a dog. At the same time, ancient Egyptians saw traits of the Anubis in every dog. It would, therefore, be correct to say that the symbolic model of AI is flawed at the level of its presupposed ontology — the idea of the order of existence.

Ontological tautology of the frame approach to AI

The next historical form of the symbolic AI approach, which became a logical continuation of the development of symbolic AI, was the frame approach. In the field of AI, the development of frame theory is associated mainly with Marvin Minsky. However, similar theoretical paradigms have been independently developed based on the methodologies of their respective sciences by anthropologists (G. Bateson), sociologists (I. Goffman), linguists (T. van Dijk), and psychologists (M. Yaroshevsky), among others.

In essence, this approach is an attempt to move from behavioristic and formal-logical simplifications of human thinking and behavior to broader structures of language and experience. In particular, Marvin Minsky described the essence of the frame as follows: "… when trying to

understand a new situation for himself or take a fresh look at already familiar things, a person selects from his memory a certain data structure (image), which we call a frame, in such a way that, by changing individual details in it, he makes it suitable for understanding more a broader class of phenomena or processes" (Minsky, 1975, p. 214). A frame is a data structure for representing a stereotyped situation, which consists of at least three components: information prescribing how to use the frame, what should happen if it is implemented, and information about methods of action "if expectations are not confirmed" (Minsky, 1975, p. 211).

Although the Dreyfus brothers' famous work aligned Minsky's views with philosophical phenomenology, their work also reflected the discoveries of contemporary cognitive psychology related to identifying cognitive or perceptual schemas. For example, Neisser (1976) defined perceptual schemas in terms close to Minsky's description of frames, as follows: "Perceptual schemas are plans for collecting information about objects and events, obtaining new information to fill out the format," but this is not all they are; "the scheme is not only a plan but also the executor of the plan. It is a structure of *action*, as well as a structure *for* action" (Neisser, 1976)

At the same time, unlike early conceptions of symbolic AI, the frame paradigm represents knowledge about the world in the form of a system of informational blocks organized in a specific manner. To update the frame, the so-called *terminals* of the frame must be filled in. These are specific variables that are responsible for encoding the empirical features of a stereotypical situation (for example, the room frame must presuppose the information related to the floor, walls, etc.) that collect information due to their structure (and are themselves organized into structures — super-frames or frame systems). Minsky's (1975) then-new approach allows us to take a fresh look at the problem of perceiving the external world through a machine (computer), which was previously practically unsolvable due to the endless multiplication of information *branching* of the outcomes of AI thinking, and solving problems in an actual situation based on this perception.

However, the frame approach only applies when human or machine thinking has identified a stereotypical situation and updated the corresponding frame. At the same time, the perception of sensory data itself is a set of multi-level frames. For example, Minsky describes the *room frame as follows*: "A typical room frame has three or four visible walls, each perhaps of a different kind. One knows many kinds of walls: walls with windows, shelves, pictures, and fireplaces. Each kind of room has its own kind of walls. A typical wall might have a 3 x 3 array of region-terminals (left-center-right) x (top-middle-bottom) so that wall objects can be assigned qualitative locations. One would further want to locate objects relative to geometric inter-relations in order to represent such facts as "Y is a little above the center of the line between X and Z" (Minsky, 1975, 9).

The unexpected complication of artificial thinking, which initially appeared to promise significant savings in mental operations, stemmed from the same ontological flaw as in earlier versions of symbolic AI (which is a naturalistic simplification of reality): the external world was depicted as a set of physical objects, and the mental and practical manipulation of these objects formed the basis of human life. The frame approach limited possible thoughts/actions to a finite

predicted volume of stereotypical likelihoods but turned out to be powerless in the face of the infinity of stereotypical situations and their endless variability.

The ontological failure of the perceptron

Around the same period when the first notable successes in the development of symbolic AI were achieved, a breakthrough occurred in the alternative direction of modeling the activity of the human mind — the construction of artificial neural networks. The first mathematical model of a neural network was proposed by McCulloch and Pitts in 1943 in the article *A Logical Calculus of Ideas Immanent in Nervous Activity.* However, the modeling of neural networks didn't gain widespread popularity until the early 1960s, after Rosenblatt created electronic devices called perceptrons (hardware designed to implement algorithms for supervised learning) that embodied the principles of their operation.

Rosenblatt expressed his thoughts on the topic in his 1958 book *The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain.* Later, in 1960, Rosenblatt's "Mark I perceptron" demonstrated elements of the ability to learn by trial and error as part of simulating human brain processes. Rosenblatt summarized his developments in recreating thinking and constructing perceptron devices in the work *Principles of Neurodynamics: Perceptrons and the Theory of Brain Mechanisms* (1962). The first wave of *connectionism* in the field of AI concluded around the turn of the 1960s to the 1970s, following the publication of the book by Minsky and Papert titled *Perceptrons: An Introduction to Computational Geometry* (1969), as well as the sudden passing of Rosenblatt in 1971. Today, researchers do not unequivocally evaluate the criticism of the capabilities of perceptrons, nor do they interpret the criticism by contemporaries, as expressed in the work of Minsky and Papert (1969). Instead, many view this case of criticism as a clear demonstration of the decline of a scientific program in line with the concept proposed by Kuhn (1962). However, neural AI also had objective problems that were not resolved even decades later. As with symbolic AI, these problems are primarily related to the ontology domain.

Since Rosenblatt's perceptron, artificial neural networks have been adept at capturing sensory information emanating from physical objects. The sensors of the Mark I device were cadmium sulfide photocells that transmitted information for further processing. However, despite the progressive advancement of perceptron devices and their eventual adaptation into computer software, which by the end of the 1960s surpassed the capabilities of specifically designed perceptron machines, they never succeeded in learning to perceive the world as humans do. This was because the objects encoded by the neural structures of the human brain did not belong to the physical world but to the world of culture. Physical objects constituted only one aspect of this lifeworld, which itself was constructed through culturally conditioned idealizations.

The human mind does not interact solely with tracings or reflections of external physical objects but rather with mental objects that are only partially associated with sensory data. These mental objects are not solely based on intuitive knowledge — specific skills and the ability to manipulate them, which are formed in a person during childhood through socialization — but also on values, coordinates in space and time, inclusion in cultural practices, genealogies, etc.

Therefore, even the most sophisticated perceptron would be unable to explain why the concept of human, which a contemporary individual uses to designate any individual as a representative of the mythological community, will refuse to apply the term to a representative of a neighboring but different totemic clan or tribe.[1]

Generative AI – an infinite Chinese room

A new wave of connectionism emerged in the last decade of the 20th century, marking a new era in developing neural AI. This wave peaked in 2022 with the widespread availability of Large Linguistic Models (LLMs), which formed the foundation of what is known today as generative AI. Products such as ChatGPT (Generative Pre-Trained Transformer), GPT-4, and Gemini/Bard have significantly impacted the average user's thinking. Experts and ordinary people are still just trying to grasp the opportunities and threats that have opened up for humans associated with a new type of AI, and governments are already forced to introduce restrictions on its use (Pause Giant AI Experiments, 2023) and development. LLM-based generative AI seems to do almost everything a thinking person can do — create texts, solve problems, answer questions, and so on. Moreover, generative AI outperforms humans by leaps and bounds in scenarios requiring rapid processing of vast amounts of data. However, closer examination of how it achieves this reveals that it does not do so in the same way humans do and perhaps does not even do at all what a person does.

Large linguistic models, the foundation of generative AI, are large-scale multilayer neural networks that are pre-trained on vast volumes of textual data. F. Rosenblatt predicted something similar in his 1962 work, outlining a promising multilayer perceptron model. The operating principle of LLM comes down to calculating the probable next word to an existing expression based on the statistical processing of a huge number of similar texts. At the same time, since the neural network operates not with the word itself but with its mathematical representation, such terms as *text* and *word* can refer to any symbolically expressed object.

Apart from the software, all that is required for LLM is a dataset used for training and instructions for its *learning* process. Leveraging the highly sophisticated architecture and immense computing capabilities of modern computers, LLM processes information by utilizing hundreds of billions of parameters (to be precise, the GPT-3 model had 175 billion such parameters), selecting the most probable continuation of a mathematical series that represents something in reality.

It is important to note that the reality processed by LLM undergoes preprocessing (in the form of internet texts, images, and sounds) before being mathematically formalized. The neural network works with the symbolic universum of meanings, establishing patterns among its elements (sometimes known only to it) and selecting the one that appears the most relevant (from the standpoint of mathematical algorithms embedded in it). We are talking about a kind of (very sophisticated) search for some potentially known element within a preloaded database. The difference between LLM and a primitive program that performs face identification within a

[1] For example, representatives of a tribe who consider a parrot to be their totem will never recognize as equals a tribe that considers an alligator to be their totem.

predefined database of faces is that LLM can create a new element based on similarity with existing analogs. That is why the infrastructure responsible for processing data in modern LLMs often surpasses the data itself. For instance, in the GPT-3 model, the processing apparatus is almost twice the size of the data it operates on (700GB versus 420GB)!

Generative AI has not addressed the challenges faced by symbolic and neural AI; in fact, it has not even attempted to address them. Instead of AI developing a consistent ontology of reality similar to the one given to humans and developing a code of rules that allows AI to work with its elements, as people do, generative AI gained access to the divine book of the results of human's work with this reality — the Internet. Although on the Internet, there are no internal human processes for processing information, thinking, experiencing, and such, it contains abundant information about the outcomes of such processes, often formulated in the form of a meaningful sentence, including cases when the subject of the description is information processing, thinking, and emotions. We can describe everything on the endless internet that AI has access to. Moreover, it does not matter how we arrive at these results; the main thing is that both humans and AI come to approximately the same conclusions based on the same logical premises!

However, the similarity of the results is not always necessary. The fact that the most advanced LLM models and types of generative AI based on them are able, following the laws of the mathematical universe, to select relevant texts from a book on the Internet does not make them something fundamentally different from the person from the Chinese room[2] (Searle, 1980). Therefore, the order of reality, the objectivity inherent in it, and the goals and values that a person associates with it remain, for the new type of AI, as impenetrable as they were for its predecessors. Moreover, the fact that the generative AI can always say something about them and even take them into account when calculating his actions does not change anything. Rephrasing Edmund Husserl that even a deaf person can study sounds (Husserl, 2001, p. 178), the fact that in generative AI studies reality doesn't mean that the reality exists to it.

What is ontology for intelligence and AI?

It is easy to notice that the basis of ontology, as a fundamental interpretation of the entity that the creators laid down in their AI models for decades, was based on the most simplified and, from a philosophical standpoint, marginal concepts of reality. These marginal concepts are either based on *primitive naturalism* (as in the case of early AI theories) or *subjectivism* (as is the case of modern generative AI). In primitive naturalism, a person perceives precisely what *really* exists and how. In subjectivism, the idea is that thinking can never go beyond subjective interpretations to the point that there is no real existence at all.

In other areas of scientific research, such simplification could be ignored for the time being. However, the field of AI acts as an integral field in which knowledge accumulated in other sciences is collected and cleared of simplifications and idealizations. Otherwise, we will face

[2] Chinese room argument is a thought experiment by the American philosopher John Searle, designed to show that human thought or intelligence can be realized artificially in machines that exactly mimic the computational processes presumably underlying human mental states—is false.

disasters in the field of unmanned vehicles, logistics, medicine, and military affairs. In the future, with the introduction of the Society 5.0 paradigm (The concept of Society 5.0), anomalies in global planning, economics, communications, and so on will occur wherever AI is being used or will be used soon.

So, are we ready to entrust the regulation and even management of human social reality to a technology that does not have access to this reality?

Ontological function of meaningful perception of reality

The state of a *thinking subject* at the moment of meaningful perception is the direct actualization and articulation of the existence of something that is not reducible to what is directly perceived. Thinking (which, of course, is formalized with the help of language) fixates (in the very thought about something) the existence of something greater in the thought (or at least equal to it) than thinking itself. For example, in the Parmenidean act of thinking (Poem of Parmenides, Perseus) about being, there is not only thought about being but also (at least conceivable) the being; Platonic ideas are seen by the mind (present in it directly) in the very act of thinking about them; discovering oneself in thinking about oneself is the existence of a self, which Descartes wrote about, at least in this very act, etc.

A person discovers what exists in an act of direct and obvious perception, perceiving the presence (here and now) of some entity as a special case of the existence of an entity. Moreover, it is equally evident that there is neither the present, its meaning, nor the world as a whole for AI. The mathematical measurement of reality can be tied to any spatial coordinates without requiring the idea of the world as a whole. For the *mathematical thinking* of AI, any of the possible scales of objects of reality (be it the microworld of atoms or the macroworld of quasars and galaxies), the physical type of this object (gases, impenetrable bodies, radiation) and even the type of reality itself (understood in accordance with the mythological hylozoism (the study, which considers all objects to have a soul), religious pantheism or, say, dialectical materialism) will be not only equally acceptable but also simultaneously applicable. The world as an existing thing and all its elements remain beyond the realm of artificial thinking.

The significance of a person's meaningful perception of the world lies in the fact that the discovery of the presence of meaning actualizes the (definite, articulated) existence of the external (the world in itself). Outside of this semantic-activity articulation, such actualization remains a potential source of an infinite number of meanings belonging to possible world realities, which is precisely why it is absorbed by uncertainty. At the moment of ontological actualization in human thinking, *the external world* comes into being in the form given by the culture that formed the person, distinguishing the existing reality from a myriad of possible realities that give clearance to the pre-existent darkness of the *external*. Hence, the ontology of thinking elevates a person 1) above an arbitrarily developed animal, which, by above arbitrarily evolved animals, is fixating on significant sensory complexes (complexes consisting of huge datasets related to feelings), merely capturing the existing *springhead* of their own *umwelt* (a term coined by Jacob Uexküll to designate a segment of physical reality shaped during the activity of a living being and dependent on its biological characteristics) and leaves the outside in

the darkness of uncertainty, and 2) above Artificial Intelligence, capable of simulating myriads of worlds, but unable to verify the presence of meaning (i.e., not possessing knowledge of the actuality of the existence of what is present).

Is it possible that AI is capable of knowing what actually exists?

Indeed, in times when generative AI models are emerging one after another, and the potential of their application is not only unexhausted but has not even been adequately explored, it seems untimely to talk about alternative AI paradigms. Nevertheless, as AI lacks access to reality, despite its advancements, it cannot be considered a full-fledged intelligence – it continues to be, albeit a remarkable one, a type of device or automaton. Hence, it seems quite appropriate to ask a theoretical question: *in what case could AI perceive and think about the world like a person?*

It is evident that the human mind never directly accesses the external world; instead, it consistently relies on specific cultural forms that function as the transcendental condition (which is universal and a priori) of human perception and cognition. Moreover, even those forms that we use to represent the *world in itself* are, so to speak, mixed forms, i.e., those that contain something natural (determined from outside) and something human (determined by our physiology and society). The world beyond socially conditioned perception is something transcendent that cannot be consistently imagined. All our knowledge about the surrounding world is acquired through social experience (obtained during socialization), which is the flip side of our social nature. Again, it is evident that this experience is not obtained as a ready-made system scholastically taught in some *university of life*. On the contrary, encyclopedic and systematic knowledge about the world derives from practical knowledge acquired through specific life practices. These practices can be considered the empirical basis of theoretical generalizations, outside of which theory has no meaning: everything we know in one way or another relies on the totality of human experience and loses its meaning outside of it. The articulation and clarification of the meaning of each concept used by a person, designed to explain the essential features included in the meaning of the concept, is reduced to its logical limitation (up to the level of the individual) within the limits of specific practices, in which we directly encounter the elements of the scope of this particular concept. At this empirical level, we finally verify the theoretical components of those symbolic formations that help us orient ourselves in reality. That's why our world is formed of practices connected with scientific understanding, and the Medieval world was formed of practices connected with Christianity.

Thus, natural intelligence can be conceived as a collection of cognitive schemas for pertinent social interactions, comprising 1) spatial and temporal coordinate systems that create the game field, 2) potential player positions, 3) the rules of engagement (including various legitimate moments of the game); and 4) intermediate and ultimate game objectives. The choice of a particular game is determined by the nature of the situation and the strategic plans of the person (a sort of *metagame*, a game that is formed above other forms of games), which encompass factors such as current location, prevailing circumstances, the immediacy of the need for specific results, etc. Unlike the unintentionally primitivized ontologies of the frame or

perceptron paradigms, the ontology of gaming AI, similar to the ontology that a person deals with, is formed in the game itself, more precisely, in the gaming system. The operation of AI is focused on accomplishing tasks within the current (ongoing here and now) game, with surrounding objects identified (recognized) precisely as elements of the playing field (the part of the lifeworld on which a particular game is being played), whose presence is either essential or potential. The transition from one game to another is guided by a *strategic game* (ultimately, for humans, a *metagame* of the meaning of life. For AI, this could be the benefit of humanity or each individual person). The logic governing the transition is established by the hierarchy of games within the *metagame*, and ensuring compliance with the game's conditions, safety, and strategic justification can be likened to consciousness.

Thus, the world appears as a totality of intertwined social games, the repertoire, and scenarios determined by culture. Natural intelligence is realized through engaging in a game or transitioning from one particular game to another within *metagames* associated with strategic or meaningful objectives.

An AI built around the game concept described above is, to some extent, an organized system of game scenarios that are subordinated to established goals. *Things* are defined by AI only as elements of playing fields and indicate related (that is, those that use similar things) social games, to which the transition can be quite logical. In a universe built in this way, it is possible to develop patterns within and across games, enabling AI to select game tactics and strategies autonomously.

This allows for avoiding the error of naturalism, not hypostatizing some independent reality, and modeling the intellectual activity of the human mind as a flexible transition between different scenarios of social action to achieve a strategic goal. As such, the gaming model of AI is just a consequence of a particular ontological theory designed to correct the vulgar realism inherent in existing AI paradigms.

The game approach considers that the ontological stability of our world of things is a function of our physiology and the habitual (for the modern human culture) way of relating to the world. The modern approach to transforming reality is formed at the intersection of many social practices = games (metallurgy, jurisprudence, population reproduction, aesthetic pleasure from contemplating nature, etc.), the complex of which has been historically established and cannot be changed by an effort of will (at least simultaneously). Moreover, if thinking means building ideal plans for reality, then existing AIs either *think* of the non-existent reality of physical things themselves or something that has no direct relationship to reality. *That is, they do not think at all.* Moreover, their *thoughts* about the world are nothing more than Husserl's deaf person's knowledge about sounds.

The game theory takes us back to the objective state of affairs: our knowledge of the world is tied to existing scenarios of social action, and success (based on reason and freedom) is determined by the ability to navigate the universum of games. In addition, the presence of a metagame of filling the life path with meaning, raising a person's thinking above private social games and introducing it into the general order of existence, forms the ultimate horizon of reality – never given directly, but ordering what is perceived empirically, and also serving as the most

general plan of social action – and shows that we still know more than just facts[ii]. In the end, by playing social games, or, in other words, *playing* the game of life, a person not only shapes social reality but affirms it existentially, which is not possible for AI to achieve.

The age of AI and education: future prospects

Time will tell whether humans can modify their thinking about AI to align more closely with the worldviews characteristic of Homo sapiens. However, AI is already transforming the world and humanity, particularly in critical areas of life. One of the most significant impacts anticipated in the field of education is that it can be split into three key areas.

First, a wide array of specialized fields will emerge dedicated to interacting with generative AI across nearly all areas of human activity. This approach is justified because new AI models will be created by a specialized group of experts (and potentially by the AI itself). At the same time, their capabilities will be utilized by virtually all computer users with internet access.

Second, like other critical social spheres such as medicine, education will become increasingly personalized, specialized, and targeted. The expanding range of necessary specializations may necessitate a revision of the current algorithms for licensing and accreditation of educational fields by the state and could potentially alter the functions of universities.

Third, delegating certain intellectual functions to artificial intelligence will fundamentally shift the paradigm of education. In the past, the invention of writing led to a decline in the need to memorize extensive mythological narratives, such as the *Odyssey* and the *Iliad*. At the same time, the advent of printing brought about a more unified and standardized approach to education. Today, humanity has gained a tool for the creative organization of thoughts — the most intricate and profound capability of human cognition. We are still in the process of understanding and harnessing its full potential.

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[i] Come now, I will tell thee - and do thou hearken to my saying and carry it away - the only two ways of search thatcan be thought of. The first, namely, that It is, and that it is impossible for anything not to be, is the way of. conviction, for truth is its companion.. The other, namely, that It is not, and that something must needs not be, - that, I tell thee, is a wholly untrustworthy path. For you cannot know what is not - that is impossible - nor utter it;

[ii] See Dreyfus, p. 33: «What sustains AI in this impasse is the conviction that the commonsense knowledge problem must be solvable, since human beings have obviously solved it. But human beings may not normally use commonsense knowledge at all. As Heidegger and Wittgenstein pointed out, what commonsense understanding amounts to might well be everyday know-how. By "know-how" we do not mean procedural rules but knowing what to do in a vast number of special cases.57 For example, commonsense physics has turned out to be extremely hard to spell out in a set of facts and rules. When one tries, one either requires more common sense to understand the facts and rules one finds or else one produces formulas of such complexity that it seems highly unlikely they are in a child's mind»

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Mexican Higher Education: New Legislation Impact and Challenges

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Abstract

This qualitative case study explores changes Mexican higher education institutions face due to recent legislation and new regulations. Constitutional amendments, a new higher education Act, legislative mandates, and updated standards to evaluate institutional effectiveness are starting to be implemented. The study examines a contemporary phenomenon that is still in process. Findings are presented thematically as a narrative and are based on the qualitative analysis of various documentary data, including recent legislation, government decrees, accreditation standards, and other relevant sources. Interview responses provide the participant's understanding of the new legislative mandates' foreseen effects on their institutions and the overall Mexican higher education system.

Keywords: universities, Mexico, legislation, accreditation, quality, internationalization

During the mid-1990s, I had the privilege of directing the institutional self-study for accreditation of a Mexican university, a time when the concept of accreditation was a novelty for most institutions in Mexico (Ríos, 1994). This was a period of significant change in Mexican higher education, with institutions exploring internationally recognized methodologies for quality improvement. Since then, the Mexican education system has undergone numerous changes, as is the nature of countries and educational systems. The aim of this qualitative case study is to provide a current snapshot of Mexican higher education through an essay-like narrative, a common approach in qualitative research. The research question guiding this study is: What are the major contemporary developments in Mexican higher education that raise quality assurance issues?

Method and Procedure

This qualitative research case study analyzes multiple documentary data sources, including recent legislation, government documents, institutional proposals, accreditation standards, and other relevant documents. The research was conducted during the Summer and Fall of 2023.

The project follows Creswell's (2008) definitions of qualitative inquiry. The qualitative approaches used included case study and descriptive research, legal research, policy analysis, and document analysis. A qualitative case study examines a particular phenomenon, gathering data from a variety of sources, and the findings are presented in a narrative that describes the case. Descriptive research defines the phenomenon being studied as it is at the time of the study. Legal research is required to study legal issues, such as legislative mandates. Document analysis is used in descriptive research to explore the status of some phenomenon at a particular time. As Best and Kahn (2006) have stated, documents are an important source of data. Examining

relevant documents helps evaluate or explain social issues, policy matters, or legal decision-making.

In addition to the document analysis, some accrediting organizations officials and Mexican university stakeholders were interviewed. Most of the interviews took place via Zoom, but some respondents expressed their points of view via email. I conducted the interviews as the author of this paper and as an individual investigator. I contacted the accrediting agencies and the offices of several Mexican universities' presidents (rectors). I received responses from high-level administrators of some institutions, university presidents, provosts, and academics in charge of institutional effectiveness. Officials from accrediting organizations communicated with me by email. Eight interviews were held for the research reported here. All of the interviewees had been involved, in some way, in quality assurance processes or were in charge of international initiatives. In order to protect the anonymity of the persons interviewed, names and affiliations are not included in this narrative; I will refer to them as "participants" throughout this article.

As I have done in prior research projects, I followed the qualitative interviewing strategies endorsed by Rubin and Rubin (2012) and Seidman (2013). I was particularly interested in the participants' perspectives; therefore, as the qualitative approach recommends, I encouraged them to provide their own experiences and viewpoints during the interviews. Creswell (2008, pp. 140-141) has indicated that in qualitative research, "participants set the direction" of the narrative. As I have discussed elsewhere, citing Creswell (2008), qualitative theories point out that individuals construct their own meaning from lived experiences and that researchers should value the subjectivity of the participants' experience (Ríos, 2019).

Discussion on contemporary developments in Mexican higher education

The following discussion and narrative resulted from analyzing the literature on the issues, document analysis, and interview responses. The literature review included the general areas of accreditation and assessment in Mexican higher education. As part of the case study, an overview of current and important issues in Mexican higher education is presented.

In the last five years, higher education institutions have seen many upcoming changes and legal demands for the near future. On May 15, 2019, the Mexican Constitution was amended to address higher education responsibilities regarding access, equity, and quality (Reforma, 2019). New legislation was passed in 2021 to implement the Constitutional changes. The legislation provided a timeline for implementing the mandates, starting in 2022. Accountability and accreditation entities were created, or their scope was expanded, to ensure that the aims of the new legislative acts were met.

Since the 1990s, efforts have been made to develop adequate quality assurance mechanisms throughout the Mexican higher education system. Accreditation and assessment initiatives emerged as important processes in the pursuit of quality. Several entities and accrediting organizations were established more than thirty years ago; some examples are the *Comités Interinstitucionales para la Evaluación de la Educación Superior, CIEES* (Interinstitutional Committees for the Evaluation of Higher Education), the *Comisión Nacional de Evaluación CONAEVA* (National Higher Education Evaluation Commission), the *Centro*

Nacional de la Evaluación para la Educación Superior, CENEVAL **(**National Center for the Evaluation of Higher Education), and others. These entities have worked through the years to support higher education quality. Participants in the study acknowledged that the work for assuring high academic quality has been in place for many years. However, quality assurance organizations have struggled with the growing number of higher education institutions and programs.

In the last thirty years, Mexican higher education has grown exponentially. As the National Association of Higher Education Institutions (Asociación Nacional de Universidades e Instituciones de Educación Superior, ANUIES) reported in 1997, there were about 200 private 98 public higher education institutions. In the school year 2017-2018, the number of institutions increased to 2,218 private and 968 public. By the 2020-2021 school cycle, there were 2,570 private and 1,008 public higher education institutions, totaling 3,578 (ANUIES, 2018; ANUIES, 2022).

According to the ANUIES (2022), the higher education system enrolled more than 4,983,204 students in the academic year 2020-2021. In addition, Mexico has diversified its university system, including technological, polytechnic, distant learning, and open universities. Despite the increase in the number of institutions and the high enrollment, the demand for access has not been met.

A pattern of inequity in access to higher education has been evident for a long time. The different documents reviewed report the social inequalities (ANUIES, 2018; CONEVAL, 2018; UNAM, 2018; INEE, 2018). Bright and qualified youngsters conclude their high school level studies to discover that there is no place in higher education for them. This is more frequent if their families are economically disadvantaged or if they live in rural areas of the country. There is a huge gap across the states of Mexico regarding the availability of high-quality higher education. The need to increase higher education access, equity, and quality has been documented and has become a social concern.

Access, quality, and equity at the heart of the changes

Increased demand for equitable access to higher education nationwide and social demands for addressing the inequalities in the national education system were at the core of the introduction of the bill that started the formal procedure for the amendments to the Mexican Constitution, referred to as "*Reforma Constitucional."*

Two documents produced by higher education institutions in 2018 demonstrated that fundamental changes were needed at the national level to address the challenges faced by the country. At the heart of the problems were issues of access and equity. In 2018, the National Association of Higher Education Institutions *(Asociación Nacional de Universidades e Instituciones de Educación Superior, ANUIES)* published a comprehensive proposal to improve Mexican higher education. The document demonstrated essential changes and new public policies to support higher education were necessary. The publication intended to reach federal and state authorities, policymakers, and society. The institution's members of ANUIES and public and private members collaborated on elaborating the proposal (ANUIES, 2018). The

proposal had crucial data about the need to expand quality higher education and presented the grave equity gaps across the country's different regions. Graphics on the inequalities in the education system across the county in the proposal made a compelling case for urgent action. Improving the quality of higher education, creating a national system for evaluation and accreditation, and fostering internationalization were key points in the proposal. The need for policies on the financial responsibilities of federal and state governments was stressed, as well as the requirement of a modernized organizational framework for the higher education system that would facilitate the mobility of students and academics. The social responsibilities of higher education institutions were explicitly emphasized in the document (ANUIES, 2018).

In coordination with the ANUIES, the national university UNAM (*Universidad Nacional Autónoma de México)* produced a parallel document about the need for consolidating public policies in science, technology, and innovation (UNAM, 2018). Both proposals demonstrated the importance of education as "fundamental for social development, economic growth, and the construction of a more equitable country" (ANUIES, 2018, p. 13).

According to the documents reviewed and the participant responses for this case study, there have been growing social concerns about the lack of equity in the availability of higher education across the nation. Innovation and expansion of the higher education system are indispensable. Fundamental changes are needed (ANUIES, 2018; CONEVAL, 2018; UNAM, 2018). The Constitutional amendments to articles related to education (Constitutional Articles Three, Thirty-One, and Seventy-Three) were made officially public on May 15, 2019 (Reforma, 2019)

My focus will be on the amendments to Article Three of the Constitution. The amendment to Article Thirty-One added some wording to parents' duties for their children's education, and Article Seventy-Three refers to rural schools and the preparation of teachers. Discussion on these later articles could be the subject of another paper. It is important to notice that until the Constitutional amendments of 2019, higher education had not been explicitly considered a right for every person by the Mexican Constitution. In the past, the Constitution only included the right to education for initial educational levels. In 2013, Constitutional amendments made the *"educación media superior"* (high school level equivalent) a Constitutional right. With this recent constitutional reform in 2019, higher education has become a right for every individual for the first time in Mexican history. The state must provide access to free higher education, and therefore, federal and state public higher education institutions must provide education at no cost to qualified individuals, *Gratis*.

The process by which the Mexican constitution is amended

Given that this paper intends to reach an international audience that might not be familiar with the process by which the Mexican constitution is amended, I will provide a brief summary of the procedure along with some historical background. After the 1910 Mexican Revolution, a Constitutional Congress was convoked. The Mexican Constitution (Constitución Política de los Estados Unidos Mexicanos) was enacted in 1917, and education became regulated by Article

Three (Larroyo, 1978). Note that the official name of Mexico is "*Estados Unidos Mexicanos"* [Mexican United States]. The country is a federal republic integrating 31 states and a federal district. Each state and federal district has its own legislative Congress and state constitution. The states' legislative bodies enact their laws and have their constitutions. The Federal Constitution rules the whole country (Senado, 2023).

The *"Congreso de la Union"* is the legislative federal body. It comprises two legislative groups or chambers: *"Camara de Diputados"* and *"Camara de Senadores,"* which correspond to the House and the Senate in the U.S. There are 500 *diputados* and 128 *senadores.* Both legislative groups discuss federal legislation. Legislation approved by the *"Congreso de la Union"* [Mexican Congress hereafter] has been sanctioned by the two legislative bodies that form the Mexican Congress (Senado, 2023).

Any Constitutional amendment to the Federal Constitution [Mexican Constitution hereafter] has to follow specific rules stated in *Article 135 c.* of the same Constitution. The article stipulates a detailed procedure, but in summary, the amendment has to be discussed by the 31 state legislatures and the Mexican Congress. It must be approved by two-thirds of the Mexican Congress and the majority of the state legislative bodies (Senado, 2023). Keep in mind that national constitutions reflect the will of the people, *"We the people…"* Constitutional amendments are prompted by citizens' demands or widespread social concerns.

New legislative act on higher education

Following the publication of the amendments to the nation's Constitution, the Mexican Congress *(Congreso de la Union)* started working on legislation to support the amendments. For two years, during the pandemic, Congress prepared the necessary legislation to ensure that the new language in the Constitution was supported by law and regulations. The Mexican Congress was engaged in an extensive consultation process, gathering perspectives from multiple sources, experts, and public opinion. After lengthy debates and revisions, Congress passed several legislative acts related to education, including higher education legislation.

The new legislative acts passed by the Mexican Congress intend to regulate the changes toward an equitable and inclusive educational system. The regulations stipulate that access to quality education at every level is a universal right for every person in the country. The legislation indicates that education must be integral and intercultural, from early levels to college.

The new higher education legislation *"Ley General de Educación Superior, LGES," or in English: "General Law on Higher Education," is the equivalent of the Higher Education Act in the U.S. This legislative act replaces the previous higher education legislation* in place since 1978. Given the 2019 amendments to the Constitution and how Mexican higher education had changed in the 43 years between the two legislative acts, new legislation was in order. From now on, I will refer to the *"Ley General de Educación Superior, LGES"* by its acronym: *LGES.* The approved law was promulgated in the *"Diario Oficial de la Federación"* on April 20, 2021(LGES, 2021).

The overarching aim of the *LGES* is to implement and regulate the recent amendments to Article Third of the Constitution. The legislation stresses the right of access to free higher education. The law also safeguards the autonomy of specific public universities, academic freedom, research freedom, and freedom of expression in higher education. Among its provisions, the legislation sets out students' rights to receive quality higher education. Enshrining these rights in law should lead to significant changes in evaluating the effectiveness and quality of higher education programs and services.

The cost of attending a Mexican public university has been pretty low compared to U.S. public higher education institutions. Through the years, Mexican public universities have established some charges or fees for different services, such as admission exams, registration, annual tuition, lab fees, sports fees, etc. The fees varied from institution to institution across the country. With the new legislative regulations, public institutions have started eliminating fees to comply with the *LGES mandates*. The legislation includes provisions for governmental financing of public higher education, a process for gradual implementation of the financial and legislative mandates started in 2022. A federal financial fund was created to support free public higher education. Law now requires private institutions to provide at least 5% of scholarships in each program area. The legislation places the responsibility of providing public higher education in federal and state governments.

Accreditation and accrediting organizations

A university is conferred institutional accreditation when an accrediting organization evaluates and accredits the institution. Program or specialized accreditation is awarded to particular units, schools, or programs within an institution by a specialized accreditation body that evaluates a specific field, profession, or discipline, such as business, medicine, or psychology. Many Mexican higher education institutions, public and private, have degree programs accredited by specialized professional accrediting bodies, such as ABET (Accreditor of College and University Programs in Applied and Natural Science, computing, engineering, and Engineering Technology), AACSB (Association to Advance Collegiate Schools of Business), ACEJMC (Accrediting Council on Education in Journalism and Mass Communications), and other specialized accrediting bodies.

As discussed above, Mexican universities have been using internationally recognized methodologies for quality improvement for many years and have developed their own accreditation mechanisms. Organizations such as ANUIES (*Asociación Nacional de Universidades e Instituciones de Educación Superior*) and FIMPES (*Federación de Instituciones Mexicanas Particulares de Educación Superior*) have led their member institutions into processes of self-study and program review. The ANUIES has, at this time, a membership of 216 higher education institutions, public and private, and FIMPES accredits private institutions, with a current membership of 113 institutions (ANUIES, 2018; FIMPES, 2024). The limited number of institution members in these organizations reveals that many institutions have not achieved or

pursued membership. This has raised quality assurance concerns, especially in the private sector, where institutions have multiplied faster.

According to the participants, the organizations for quality assurance that have been operating for more than three decades need renewal (Personal communication, 2023). Quality assurance considerations included in the *LGES* prompted the establishment or expansion of responsibilities of several organisms for quality assurance and the development of a new quality assurance framework to evaluate programs and institutions. The National Council for the Coordination of Higher Education, CONACES (*Consejo Nacional para la Coordinación de la Educación Superior)* dedicated substantial effort from 2021 to 2023 to create a National System for Evaluation and Accreditation (*Sistema de Evaluación y Acreditación de la Educación Superior, SEAES).* During the year 2022, the Interinstitutional Committees for the Assessment of Higher Education (*Comités Interinstitucionales para la Evaluación de la Educación Superior, CIEES*) worked on the development of the framework for higher education evaluation: *"Marco General de Evaluación de los Comités Interinstitucionales para la Evaluación de la Educación Superior 2024, MGE-2024."* According to the CIEES organization, the *MGE-2024* framework was developed based on widespread consultation involving more than 5,300 experts and academics (MGE, 2024).

The new system for evaluation and accreditation is in its early phases of implementation. According to the participants in this study, their institutions have not yet experienced major changes due to the *LGES*. It is probably still too early to experience the changes at the campus level. The processes, as of now, are not yet mandatory. I am quoting the statement of one of the participants:

> "The biggest change I have seen is that there is a new system named SEAES (system for higher education evaluation and accreditation), which will include all accrediting standards in Mexico and also creates a new institutional self-evaluation process (they call it "self-reflection"), and although it is not mandatory yet, all private and public higher education institutions are invited to participate. In its first year (2023), about 470 out of the 3,750 Mexican higher education institutions participated" (Personal communication, 2023).

Mexican accrediting organizations have gained experience through years of quality assurance work. Their endeavors are now supported by national legislation. The new accreditation system, the MGE-2024 framework, includes revamped standards and procedures that are expected to improve the quality of institutions and programs across the Mexican higher education system over time.

International Accreditation

Currently, only a few Mexican universities maintain accreditation from a U.S. institutional accreditor for quality assurance. The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) and the Western Association of Schools and Colleges

(WASC - Senior College and University Commission (WSCUC) accredit some international universities; among these institutions are a few universities in Mexico. When writing this narrative, just four Mexican institutions had received accreditation from SACSCOC, and only one was accredited by WSCUC. As part of this study, interviews were conducted with academics and administrators from these institutions. Their responses indicate that institutional international accreditation conveys prestige to their universities and fosters internationalization (Personal Communications, 2023). These institutions value internationalization and prestige at the international level. These institutions are interested in national and international recognition of quality.

The *LGES* legislation requires that institutions meet national or international standards of quality. The legislation seems to indicate that universities can decide to pursue program or institutional accreditation by a Mexican accrediting organism, such as the CIEES; elect to seek accreditation by an international organization; or in order to demonstrate the excellence of the institution and its programs, pursue both national and international recognitions.

Institutions that have received accreditation from SACSCOC or WSCUC might not be required to be evaluated by the national quality assurance process. When preparing this narrative, participants interviewed were not sure how the language in the legislation might be applied in practice in the near future (Personal Communication, 2023).

Internationalization

There is a surprising recognition of the value of internationalization in the *LGES* legislation. For academics in the field of international education, it is reassuring that the legislation addresses higher education internationalization. The law mentions the word *"internacional"* (international) thirteen (13) times. In Article Eight, the legislation indicates that among the objectives that higher education should seek is the *"internacionalización solidaria," explaining that it means international collaboration or international collaborative support for* education. The law refers to establishing multilateral processes of international cooperation, including international exchanges, mobility across countries, and research from a diverse and global perspective. Article Nine of the *LGES* legislation points out the responsibility of higher education institutions to prepare professionals with scientific, technological, innovative, humanistic, and international vision. It stresses that international research should be promoted (LGES, 2021).

In Article Ten, the *LGES* legislation includes intercultural and internationalization as part of the criteria for elaborate higher education policies related to students' competencies. The law states that institutions should follow national and internationally recognized best practices in planning and evaluation processes (LGES, 2021, Article 60). Accreditation recognitions by international accrediting bodies are acceptable and seem to be encouraged by the legislation.

According to the legislation, federal and state governments are responsible for promoting the internationalization of the National System of Higher Education through mobility agreements and other forms of international cooperation (LGES, 2021).

Case Study Analysis and Recommendations

When conducting a case study research, an investigator has little control over events, as the analysis is on a contemporary phenomenon that might still evolve (Yin, 1989). The case study discussed in this paper has some elusive trends as the implementation of the new legislation is in its preliminary stages, and there are many unknowns. Participants in this research case study wondered how implementing the legal mandates might eventually affect their university campus and work (Personal Communications, 2023). I found that the participants had not yet read the complete legislation of *LGES.* I was not surprised at this, as in my experience, comprehensive legislative decrees are just consulted when necessary but are not read by everyone affected by the legislation. How many academics in the U.S. have read the full text of the last reauthorization of the U.S. Higher Education Act? I hypothesize that there are not many.

The *LGES* legislation has made higher education an important priority for the country, and federal and state governments are responsible for financing public higher education. Participants wondered if the government could provide the necessary funds over time. As mentioned earlier, the process for gradual implementation of the financial legislative mandates started in 2022, and a fund for the support of free public higher education was created. Will the federal and state governments continue to disperse the funds to higher education when new administrations take office?

Overall, public universities are pleased that more funding will be available. For private higher education institutions, the 5% of scholarships the law requires to establish will not be difficult. It is well known that recognized private universities already have some scholarship offerings. About this matter, one of the participants stated: “Most private institutions award much more than that, so I do not think this will become a challenge, at least for non-profits” (Personal communication, 2023).

While the implementation of the *LGES* is still in the early stages, the new legislative mandates have already prompted some changes in the Mexican higher education system. A number of organisms, timelines, frameworks, and policies have been generated to implement the modifications needed. The demand for admission to public institutions is expected to dramatically increase, as public institutions must offer free quality education. Public institutions have had difficulties keeping up with the enrollment demand in recent years. New approaches must meet the demand, including expanding distance education programs and innovative technologies.

The legislation charges the government with the responsibility of supervision of the system of evaluation and accreditation (LGES, 2021). This will bring more indirect federal and state government intervention to Mexican higher education. As Schuster (1997, p. 370) has written regarding U.S. higher education: “In the public sector, the payer of bills in large measure is the states, and that helps to account for closer scrutiny of higher education by state policymakers in recent years.” There is the possibility of further government involvement and an increase in state regulations in the future.

The role of Mexican organizations in quality assurance will continue to expand. A National System for Evaluation and Accreditation is already in place. Higher education institutions are taking measures to comply with the requirements and to demonstrate their effectiveness. Institutions are strengthening their strategic priorities for internationalization and global engagement. Some institutions have re-examined their missions and capabilities to increase international openness, provide student-centered learning environments, foster research and innovation, support student employability, and demonstrate student learning outcomes.

Many issues about Mexican higher education are currently in transition and deserve additional study. Given the growth of the number of private higher education institutions in Mexico, one area that deserves further study is their proliferation, accreditation status, and internal quality assurance processes. Research is needed to study the distance education offerings across the Mexican higher education system and the approaches of accrediting agencies in evaluating online offerings. I believe that studying the academic profession in Mexico is necessary. Many issues about the faculty in Mexico would be important to research, such as qualifications, workload, salaries, ranks, and academic freedom. Finally, in about five years, it will be interesting to research how the *LGES* mandates have changed Mexican higher education.

Conclusion

Higher education institutions in Mexico are facing extraordinary challenges and uncertainty. The aims of the Constitutional amendments and new legislation are commendable. The goals and objectives included in the law are forward-thinking, seeking widespread access, equity, and inclusion in higher education, as well as stressing the importance of quality, intercultural approaches, respect for language differences, and internationalization. Several academics interviewed as part of this research indicated that they are pleased that academic freedom, freedom of conducting research, and freedom of expression are valued in the legislation. Universities with the designation of *"Autonomas*" applaud that the new legislation has reaffirmed their autonomous status, which assures self-governance and independence from the government. On the other hand, the government is now charged with the responsibility of financing free public higher education. Governmental financing might bring an increase in accountability measures and intervention from federal and state authorities into the realms of higher education (Ríos, 2007).

The Mexican higher education community, facing the arrival of a new government in the very near future, wonders if implementing the ambitious goals contained in the legislation will be achieved.

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The Causal Relationships Between Entrepreneurial Activity Types of the Global Entrepreneurship Monitor (GEM) and the Achievement of the United Nations Sustainable Development Goals

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Abstract

This study examines the causal links between entrepreneurial activity, as measured by the Global Entrepreneurship Monitor (GEM), and progress toward the United Nations Sustainable Development Goals (SDGs). Using data from 96 countries between 2011-2018, we applied Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess the effects of Total early-stage Entrepreneurial Activity (TEA), Established Business Ownership (EBO), and Entrepreneurial Employee Activity (EEA) on the SDGs within the 5Ps framework: People, Planet, Prosperity, Partnership, and Peace. Surprisingly, results show significant negative relationships between entrepreneurship and all SDG dimensions, with the strongest impact on Prosperity. Further analysis of indirect effects confirms that entrepreneurship hinders SDG progress across four of the five Ps, excluding Peace. These findings challenge the common belief that entrepreneurship is a key driver of sustainable development, revealing potential negative externalities from certain entrepreneurial activities. The study's implications are significant, suggesting the need to reevaluate entrepreneurial policies to better align with SDG goals. Recommendations are provided for policymakers, educators, and entrepreneurs to promote sustainable entrepreneurship that addresses social and environmental challenges while minimizing negative impacts.

Keywords: entrepreneurial activity, entrepreneurship, sustainable development goals, global entrepreneurship monitor, partial least squares structural equation modeling (PLS-SEM), sustainability

In recent years, the world has faced significant challenges in sectors like economic impact, poverty, inequality, education, well-being, and climate change. To address these global issues, 193 UN member countries adopted the 2030 Agenda for Sustainable Development in September 2015. The Agenda outlines 17 Sustainable Development Goals (SDGs) aimed at ensuring no one is left behind by 2030 (UN, 2015).

The COVID-19 pandemic, declared a Public Health Emergency by the WHO on January 30, 2020, and a pandemic on March 11, 2020, caused a global crisis. Efforts to contain the virus, including social distancing and lockdowns, led to substantial economic, social, environmental, and personal impacts (Gautam & Hens, 2020).

The pandemic has hindered progress toward the SDGs. A study by UNDP and the Pardee Center highlighted its long-term effects on sustainable development (UNDP, 2020). The 2020 SDG index score declined for the first time, driven by rising poverty and unemployment (Sachs et al., 2021).

The economic consequences have been severe, with global output dropping by 3.4% in 2020 (OECD, 2020). The WHO and World Bank also noted the pandemic's negative impact on health coverage, causing increased mortality from diseases like malaria and tuberculosis (WHO, 2021).

Young workers and recent graduates have been disproportionately affected by higher unemployment rates, while school closures have deprived over 1.6 billion students of quality education, worsening educational inequalities (Patrinos et al., 2022).

Addressing the SDGs has become a top priority after the pandemic. UNIDO has suggested entrepreneurship and innovation as solutions to drive sustainable development, especially with government support for SMEs (UN, 2022). The OECD has also provided guidance for supporting entrepreneurs in the post-pandemic world (OECD, 2021).

However, research on the relationship between entrepreneurship and SDGs remains limited, presenting an opportunity for further study. This research aims to analyze how various entrepreneurial activities impact the achievement of SDGs, providing insights for policymakers, entrepreneurs, and stakeholders. Ultimately, it seeks to support economic and social development and foster progress toward global sustainable goals.

Theoretical Framework and Hypothesis

Theoretical Framework on Entrepreneurship in the Global Entrepreneurship Monitor

Entrepreneurship drives economic growth, job creation, and income generation through innovation, making it a key indicator of progress (Decker et al., 2014). Measuring entrepreneurial activity is crucial, especially during crises like the COVID-19 pandemic.

The pandemic significantly reduced entrepreneurial intentions and spurred adaptations, such as shifts to online sales and remote work. It created opportunities for business models aligned with sustainable development goals, like poverty reduction and equality promotion (Ratten, 2020).

Entrepreneurial intentions are shaped by individual and environmental factors influenced by the pandemic. Access to resources, like technology, enabled some entrepreneurs to thrive while others struggled, especially in sectors dependent on in-person interactions (Sahasranamam & Nandakumar, 2018).

The Global Entrepreneurship Monitor (GEM) report, including Thailand's data, highlights the importance of a supportive environment for entrepreneurship, emphasizing access to finance, government policies, education, and business support (Beighley, 2022).

GEM’s framework links economic growth to individuals' ability to identify and access opportunities influenced by environmental conditions. This dynamic interplay is essential for understanding successful entrepreneurship.

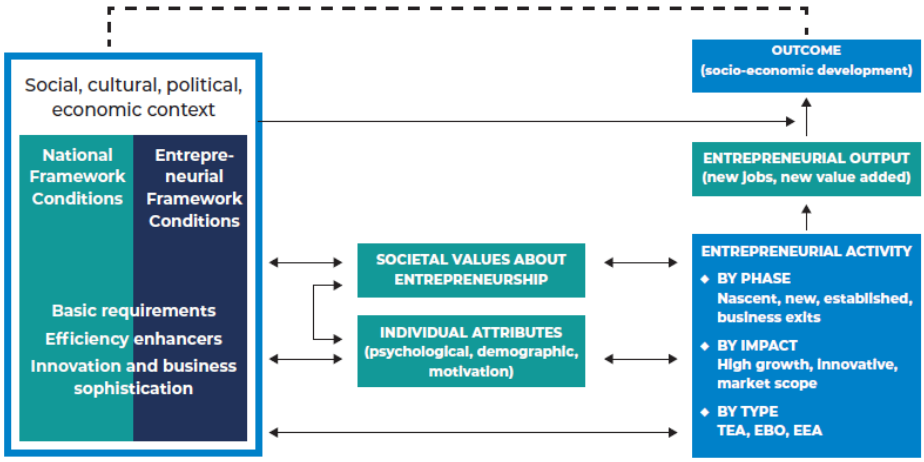
The framework identifies three key elements—opportunities, individual abilities, and environmental factors—as drivers of entrepreneurial activity, which creates social value and economic development through reinvestment in communities, job creation, and technological advancements (Audretsch et al., 2006).

The GEM framework has evolved over three stages: Stage 1 (1999–2011) focused on basic entrepreneurial metrics; Stage 2 (2011–2014) included detailed ecosystem aspects; and

Stage 3 (2015–present) broadened to cover social entrepreneurship and intrapreneurship shown in Figure 1.

Figure 1

The GEM Conceptual Framework (Global Entrepreneurship Monitor, 2023)



The current GEM framework comprises several key components:

1. **Social, Cultural, Political, and Economic Context**: This component draws from indicators like the World Economic Forum's Global Competitiveness Index and GEM National Entrepreneurial Conditions. It acknowledges that entrepreneurship is shaped by the broader societal environment (Welter, 2011).
2. **Social Values towards Entrepreneurship**: This examines how entrepreneurship is valued as a career and its role in social status and culture. Positive social values can motivate individuals to pursue entrepreneurship (Stephan & Uhlaner, 2010).
3. **Individual Attributes**: This includes demographics (gender, age, location), psychological factors (perceived ability, opportunity recognition, fear of failure), and motivations (necessity-driven vs. opportunity-driven entrepreneurship). These factors are crucial in determining entrepreneurial engagement (Shane et al., 2003).
4. **Entrepreneurial Activity**: Activities are categorized by phase (Nascent, New, Established, Business exits), impact (High growth, Innovation, Market scope), and type (TEA, EBO, EEA), providing a detailed view of entrepreneurship across different stages (Reynolds et al., 2005).

Successful entrepreneurial activities need supportive environments, opportunities, and individual skills. Key supportive factors include:

1. **Access to Finance**: Availability of venture capital, angel investors, and supportive banking systems.
2. **Government Policies**: Business-friendly regulations, tax incentives, and protection of intellectual property.
3. **Entrepreneurship Education**: Incorporating entrepreneurship into education systems and vocational training.
4. **Physical Infrastructure:** Reliable transportation, high-speed internet, and affordable workspaces.

5. **Cultural Support:** Social norms that encourage risk-taking, innovation, and business ownership. By fostering these factors, policymakers can build ecosystems that promote entrepreneurship and economic growth.

By fostering these supportive elements, policymakers and stakeholders can create an ecosystem that nurtures entrepreneurship and drives economic growth (Isenberg, 2010).

Theoretical Framework on the United Nations' Sustainable Development Goals (SDGs)

The United Nations' Sustainable Development Goals (SDGs) reflect a global commitment to achieving a more just, prosperous, and environmentally sustainable world. This framework builds on years of international cooperation and earlier efforts to tackle global challenges.

Historical Context and Evolution

The SDGs trace back to the 1992 Earth Summit in Rio de Janeiro, where leaders endorsed Agenda 21, a global plan for sustainable development (United Nations, 1992). This summit laid the groundwork for future sustainability efforts. The Millennium Development Goals (MDGs) were introduced in 2000, focusing on poverty reduction and human development until 2015 (United Nations, 2000). These goals successfully reduced extreme poverty and expanded primary education access (Sachs, 2012).

The 2030 Agenda and the SDGs

In 2015, the global sustainability movement reached a milestone when 193 UN member states adopted the 2030 Agenda for Sustainable Development, introducing 17 SDGs (United Nations, 2015). These goals address many global issues, such as poverty, inequality, health, education, economic growth, climate change, and peace. The SDGs take a holistic approach, recognizing the interconnections between economic, social, and environmental issues. For example, climate action (Goal 13) directly impacts poverty reduction (Goal 1), as climate change disproportionately harms the poor (Hallegatte et al., 2016).

The 17 Sustainable Development Goals

The SDGs, backed by 169 targets and 232 indicators, provide a roadmap for global development through 2030. Each goal addresses specific aspects of sustainability, including poverty, hunger, health, education, gender equality, clean water, energy, economic growth, innovation, reduced inequalities, sustainable cities, responsible consumption, climate action, biodiversity, peace, justice, and partnerships (United Nations, 2015). shown in Figure 2.

Figure 2

17 Sustainable Development Goals (United Nations, 2024)

SDG 4 (Quality Education) and SDG 5 (Gender Equality) exemplify how interconnected the Sustainable Development Goals are. Improved access to education, especially for girls, enhances gender equality, drives economic growth, and strengthens climate resilience (UNESCO, 2020), illustrating how progress in one area supports multiple SDGs.

The Five Dimensions of Sustainable Development Goals

The United Nations has grouped the 17 SDGs into five key dimensions, known as the "5Ps," providing a comprehensive framework to showcase their interconnection and global impact.

The 5Ps: A Holistic Approach to Sustainable Development

The five dimensions of sustainable development, as illustrated in Figure 3, are:

People: Focuses on ending poverty and hunger, ensuring all people live with dignity and equality.

Planet: Aims to protect the environment through sustainable practices and urgent climate action.

Prosperity Seeks balanced progress where economic, social, and technological development occur in harmony with nature.

Peace: Promotes peaceful, inclusive societies as essential to sustainable development.

Partnership: Emphasizes global cooperation and support, especially for the most vulnerable.

Figure 3

5 Dimensions of Sustainable Development (5Ps) (UN General Assembly, 2014)

These five dimensions form a comprehensive framework for tackling the complexities of sustainable development. They underscore the interrelatedness of social, economic, and environmental issues, indicating that progress in one area often relies on and fosters advancements in others.

Linking the 5Ps to the 17 SDGs

As shown in Figure 4, the 5P framework is closely tied to the 17 SDGs. This connection illustrates how each dimension includes multiple goals, emphasizing the integrated approach essential for achieving sustainable development. The distribution of the SDGs across the five dimensions is as follows

Figure 4

5 Linkage between 5 Dimensions and 17 SDGs (SDG Move, 2017)

- **People**: SDG1 (No Poverty), SDG2 (Zero Hunger), SDG3 (Good Health and Well-being), SDG4 (Quality Education), and SDG5 (Gender Equality)

- **Prosperity**: SDG7 (Affordable and Clean Energy), SDG8 (Decent Work and Economic Growth), SDG9 (Industry, Innovation and Infrastructure), SDG10 (Reduced Inequalities), and SDG11 (Sustainable Cities and Communities)
- **Planet**: SDG6 (Clean Water and Sanitation), SDG12 (Responsible Consumption and Production), SDG13 (Climate Action), SDG14 (Life Below Water), and SDG15 (Life on Land)
- **Peace**: SDG16 (Peace, Justice and Strong Institutions)
- **Partnership**: SDG17 (Partnerships for the Goals)

As nations and organizations strive to achieve the SDGs, recognizing and leveraging the interconnections among goals is crucial. Policies and programs should adopt a multi-dimensional approach that considers ripple effects across the 5Ps. This integrated strategy not only enhances the effectiveness of sustainable development initiatives but also helps identify and mitigate potential negative consequences stemming from a narrow focus on individual goals.

The 5P framework offers a valuable perspective for implementing the SDGs by highlighting the interconnectedness of these dimensions. This encourages a holistic approach to sustainable development that acknowledges the complex relationships between social, economic, and environmental factors, ultimately fostering a more equitable and sustainable world for all.

Data Analysis Using Partial Least Squares Structural Equation Modeling (PLS-SEM)

Partial least squares structural equation modeling (PLS-SEM) is a powerful statistical technique widely used across research fields. Two primary methods exist within structural equation modeling (SEM): Covariance-Based Structural Equation Modeling (CB-SEM) and PLS-SEM. While both analyze complex variable relationships, they have distinct purposes. CB-SEM confirms theories by evaluating whether a theoretical model can reproduce the observed covariance matrix, making it suitable for testing specific hypotheses when a strong theoretical foundation exists (Hair et al., 2017).

In contrast, PLS-SEM employs a causal-predictive approach, focusing on explaining variance in dependent variables (Jöreskog & Wold, 1982, p. 270; Chin et al., 2020). This method is beneficial for predicting key target constructs or identifying drivers. For example, PLS-SEM can predict customer satisfaction based on factors like product quality and service experience (Hair et al., 2021).

PLS-SEM's popularity has grown significantly over the past decade, with many researchers recommending its application across various disciplines (Hair, 2022). This trend has spurred in-depth analyses of its methodology, including authorship patterns and citation networks (Hwang et al., 2019; Khan et al., 2018). A bibliometric analysis by Ringle et al. (2020) indicated that PLS-SEM applications are expanding beyond traditional fields such as management and marketing to areas like information systems and healthcare.

To effectively use PLS-SEM, researchers must understand its characteristics and statistical properties as they influence assessment outcomes. The analysis process involves four key considerations: (1) **Data characteristics** (sample size, distribution, and missing

data), with PLS-SEM effectively handling non-normal data and small samples (Hair et al., 2019); (2) **Model characteristics** (complexity and number of constructs); (3) **Model estimation** (iterative approach to maximize variance explained in endogenous constructs) (Hair et al., 2011); and (4) **Model performance evaluation** (measuring reliability and validity, path coefficients, R-squared values, and predictive relevance) (Hair et al., 2019).

Researchers increasingly advocate for PLS-SEM in causal prediction, especially in business research. Many business journals feature predictive statements for management based on empirical findings, relying on robust model evaluation. PLS-SEM effectively demonstrates structural relationships and makes predictions (Sarstedt & Danks, 2021; Hair & Sarstedt, 2019, 2020). For example, Henseler et al. (2016) used PLS-SEM to predict customer loyalty in telecommunications, identifying key drivers such as service quality and perceived value, thus providing actionable insights for managers.

In summary, PLS-SEM has become a valuable tool for researchers aiming to understand complex relationships and make predictions across various fields. Its flexibility, capacity for handling complex models, and emphasis on prediction make it particularly suitable for business and management studies.

A Systematic Literature Review of Entrepreneurial Activity Impact on Sustainable Development Goals

Entrepreneurship has emerged as a powerful force in shaping global economic landscapes and addressing societal challenges. This systematic literature review examines the intricate relationship between entrepreneurial activities and achieving Sustainable Development Goals (SDGs). By exploring three key aspects - types of entrepreneurial activities, categorization of SDG targets, and the effects of entrepreneurship on SDGs - this review aims to provide a comprehensive understanding of how entrepreneurial endeavors contribute to sustainable development.

Types of Entrepreneurial Activities

The literature identifies two primary metrics for quantifying national-level entrepreneurial activity:

1. **Total Early-Stage Entrepreneurial Activity (TEA)**: This widely used measure indicates the percentage of adults (ages 18–64) engaged in starting or managing new businesses, reflecting the dynamism of a country's entrepreneurial ecosystem (Kim, 2022).
2. **Established Business Ownership (EBO)**: This metric represents the percentage of adults who have owned or managed a business for over 42 months, indicating the stability and longevity of entrepreneurial ventures within an economy (GEM, 2021). These metrics provide insights into various stages of entrepreneurial activity, from inception to established businesses, facilitating the analysis of entrepreneurship's impact on sustainable development.

Categorization of SDG Targets

The review identifies two primary approaches to categorizing SDG targets, each offering a unique perspective on sustainable development:

1. **Three Pillars of Sustainability**: Gafar (2022) and Dhahri et al. (2021) utilize this classic framework, categorizing SDGs into:
   - Social: Focusing on human well-being, equity, and social justice
   - Economic: Addressing poverty reduction, economic growth, and prosperity
   - Environmental: Concentrating on ecological balance and resource conservation
2. **Five Dimensions Approach**: Venâncio and Pinto (2020) align their categorization with the United Nations framework, grouping the 17 SDGs into five dimensions (SDG Move, 2023b):
   - People: Encompassing goals related to ending poverty and hunger, ensuring health and education
   - Prosperity: Covering economic growth, innovation, and reduced inequalities
   - Planet: Addressing climate action, life below water, and life on land
   - Peace: Focusing on justice, strong institutions, and peaceful societies
   - Partnership: Emphasizing global cooperation for sustainable development

These categorization approaches provide researchers with various lenses to analyze the impact of entrepreneurship on sustainable development.

Theoretical Overview of Entrepreneurial Activity o n Sustainable Development Goals

Entrepreneurial activity, a key driver of economic growth and innovation, is conceptualized here as a latent variable with three components based on the Global Entrepreneurship Monitor (GEM) framework. This framework defines entrepreneurship through three categories:

1. Total early-stage Entrepreneurial Activity (TEA) includes individuals starting or running a business that is less than 42 months old (Reynolds et al., 2005).
2. Established Business Ownership (EBO) refers to those who own and manage a business that has been in existence for more than 42 months (Bosma et al., 2012).
3. Intrapreneurship (EEA), or Employee Entrepreneurial Activity, where employees create new ventures or products for their employer (Bosma et al., 2013).

These three forms of entrepreneurial activity collectively represent the diverse landscape of entrepreneurship, from nascent ventures to established businesses and corporate innovation.

Meanwhile, the Sustainable Development Goals (SDGs), adopted in 2015 by all UN member states, aim to end poverty, protect the planet, and ensure prosperity for all by 2030 (United Nations, 2015). The 17 SDGs address poverty, inequality, climate change, and peace challenges.

This study links entrepreneurship to the SDGs using the "5Ps" framework—People, Prosperity, Planet, Peace, and Partnership—from the 2030 Agenda for Sustainable Development (United Nations, 2015). The 5Ps help structure and evaluate the impact of entrepreneurship on sustainable development.

Hypotheses

Based on the theoretical framework outlined above, this study proposes the following hypotheses:

H1: Entrepreneurial Activity has a significant influence on the People dimension of SDGs.

H2: Entrepreneurial Activity has a significant influence on the Prosperity dimension of SDGs.

H3: Entrepreneurial Activity has a significant influence on the Planet dimension of SDGs.

H4: Entrepreneurial Activity has a significant influence on the Partnership dimension of SDGs.

H5: Entrepreneurial Activity has a significant influence on the Peace dimension of SDGs.

H6: The People dimension has a significant influence on the overall achievement of SDG Goals.

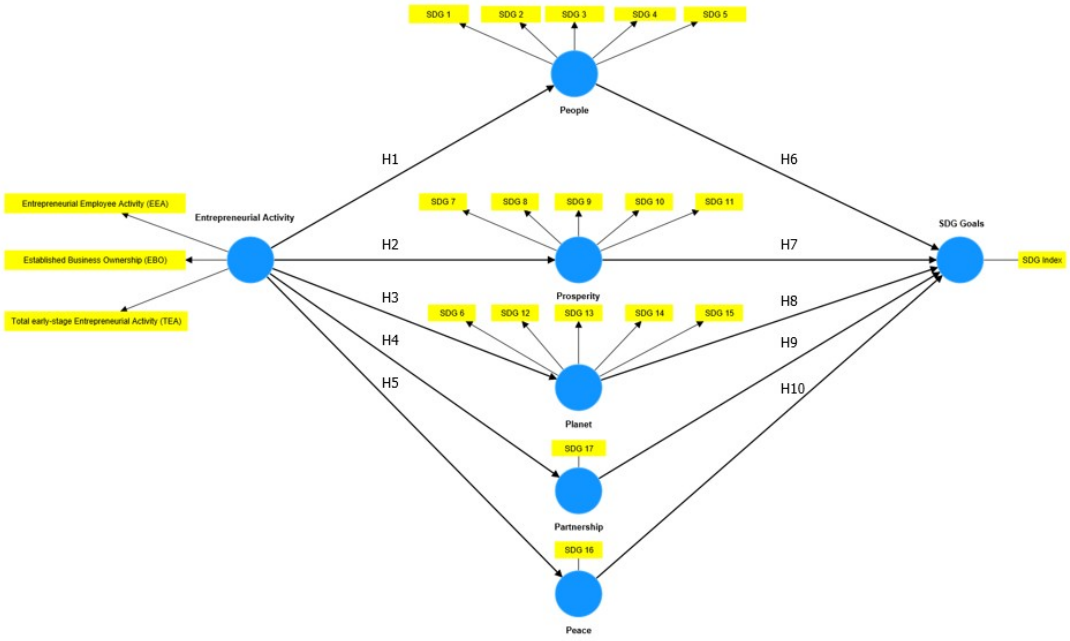
H7: The Prosperity dimension has a significant influence on the overall achievement of SDG Goals.

H8: The Planet dimension has a significant influence on the overall achievement of SDG Goals.

H9: The Partnership dimension has a significant influence on the overall achievement of SDG Goals.

H10: The Peace dimension has a significant influence on the overall achievement of SDG Goals.

Figure 5
Research model to be tested



Methodology

Source of Information

This study examines entrepreneurial activity data from the Global Entrepreneurship Monitor (GEM), and it was found that data on Entrepreneurial Employee Activity has been collected since 2011. During the COVID-19 crisis, from 2019 to 2022, GEM's collection of entrepreneurial activity data in many countries worldwide was hindered due to the inability to collect field data. Consequently, 2018 is the most recent year for which entrepreneurial activity data is available in many countries, including Thailand (Suchart Traiphopsakul, 2023). Therefore, the sample studied consists of data from reports and indexes from GEM and the UN during 2011-2018, covering an eight-year period from 96 UN and GEM member countries, including Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Belize, Bolivia, Botswana, Brazil, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Georgia, Germany, Ghana, Greece, Guatemala, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Latvia, Lebanon, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mexico, Morocco, Namibia, Netherlands, Nigeria, North Macedonia, Norway, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russia, Saudi Arabia, Senegal, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sudan, Suriname, Sweden, Switzerland, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, and Zambia. The sample size is 479, which exceeds the minimum sample size estimated using the 10-time rule method and the inverse square root method, within the minimum coefficient range of 0.11–0.2 at all significance levels of 1%, 5%, and 10%.

Data Analysis

In our empirical analysis, we use a quantitative research approach employing a Structural Equation Modeling (SEM) framework with Partial Least Squares (PLS) analysis facilitated by Smart PLS version 4. This research relies on secondary data, which presents limitations in data volume. However, PLS-SEM is advantageous in such cases due to its flexibility and lower requirements than traditional SEM methods. Hair et al. (2014) note that PLS-SEM effectively handles smaller sample sizes and is less limited by the strict assumptions of other SEM methodologies. Moreover, Nitzl (2016) emphasizes that PLS-SEM is particularly suitable for secondary data analysis as it can accommodate complex interactions between data and theoretical constructs, enhancing the robustness of the analysis.

Results

The reporting of study results is divided into two sections: Measurement Model Assessment and Structural Model Assessment, which are detailed below.

Measurement Model Assessment

Internal consistency and reliability were assessed using composite reliability (CR) and Cronbach's alpha. Table 1 indicates that the constructs meet the recommended thresholds, except for the Planet construct's Cronbach's alpha. In Partial Least Squares Structural Equation Modeling (PLS-SEM), composite reliability is typically preferred for evaluating concrete constructs (Hair et al., 2022).

The study achieved a CR exceeding the 0.6 threshold for descriptive studies (Malhotra & Dash, 2011), with values above 0.7 deemed acceptable (Hair et al., 2022). Table 1 shows all constructs' CR values between 0.817 and 0.872, indicating satisfactory consistency and reliability.

Convergent validity was measured using the Average Variance Extracted (AVE), with all latent variables surpassing the 0.5 threshold (Fornell & Larcker, 1981), scoring between 0.541 and 0.700. This confirms adequate convergent validity for all constructs.

Table 1 summarizes the measures of internal consistency, reliability, and convergent validity. The high CR values and acceptable AVE scores demonstrate that the measurement model possesses strong psychometric properties, essential for the subsequent structural model analysis in PLS-SEM (Hair et al., 2019).

Table 1
Internal Consistency, Reliability, and Convergence Validity

Latent Variable	Cronbach's Alpha	Composite Reliability (CR)	AVE
Entrepreneurial Activity	0.609	0.817	0.695
People	0.771	0.849	0.541
Planet	0.589	0.822	0.700
Prosperity	0.814	0.872	0.581

The validity of the identification was evaluated using the Fornell–Larcker criteria, which state that the square root of the variance extracted must surpass the correlation between subscales. Table 2 displays the diagonal elements (in bold) as the square root of each construct's Average Variance Extracted (AVE), while off-diagonal elements show the correlations. All diagonal values exceeded their respective off-diagonal counterparts, indicating satisfactory discriminant validity of the constructs (Hair et al., 2017).

Additionally, the internal consistency of the constructs is confirmed by composite reliability values on the diagonal, which range from 0.735 to 0.837, surpassing the 0.7 thresholds recommended for PLS-SEM analyses (Hair et al., 2011; Fornell & Larcker, 1981). This demonstrates good internal consistency and reliability of the measures.

The table also highlights notable relationships between constructs. A strong positive correlation (0.888) exists between People and Prosperity, indicating a close relationship. In contrast, Entrepreneurial Activity presents negative correlations with Planet (-0.392) and Prosperity (-0.530), suggesting trade-offs or complexities in these relationships. These findings establish a robust foundation for further analysis of latent variable relationships in this study.

Table 2
Discriminant Validity

Latent Variable	Entrepreneurial Activity	People	Planet	Prosperity
Entrepreneurial Activity	**0.834**			
People	-0.439	**0.735**		
Planet	-0.392	0.743	**0.837**	
Prosperity	-0.530	0.888	0.750	**0.762**

Structural Model Assessment

The variance inflation factor (VIF) was analyzed using partial least squares structural equation modeling (PLS-SEM), as presented in Table 3. The VIF values ranged from 1.000 to 3.674, all below the threshold of 5 (Hair, Ringle, & Sarstedt, 2011). Table 3 lists the VIF values for various latent variables, including Total early-stage Entrepreneurial Activity (TEA), Established Business Ownership (EBO), Entrepreneurial Employee Activity (EEA), and several Sustainable Development Goals (SDGs). These results indicate that multicollinearity is not an issue in our structural model, as all VIF values are within

acceptable limits, suggesting that each predictor variable contributes unique information in explaining the dependent variables, thus enhancing the reliability of our PLS-SEM analysis.

Table 3

Variance inflation factor

Latent Variable	VIF
Total early-stage Entrepreneurial Activity (TEA)	1.270
Established Business Ownership (EBO)	1.238
Entrepreneurial Employee Activity (EEA)	1.031
SDG 1	1.118
SDG 2	1.328
SDG 3	2.636
SDG 4	2.694
SDG 5	1.528
SDG 6	1.768
SDG 7	1.827
SDG 8	1.794
SDG 9	2.143
SDG 10	1.202
SDG 11	2.085
SDG 12	3.674
SDG 13	2.682
SDG 14	1.010
SDG 15	1.232
SDG 16	1.000
SDG 17	1.000
SDG Index	1.000

The final step employs bootstrapping with 5,000 resampling's to evaluate statistical significance and relevance. Table 4 displays the analysis results, highlighting the relationships among various factors impacting SDG Goals.

Table 4 indicates that nearly all hypothesized relationships were statistically significant, with p-values < 0.05. Strong negative correlations were found between Entrepreneurial Activity and factors such as People (-0.439), Prosperity (-0.530), Planet (-0.392), Partnership (-0.201), and Peace (-0.449). Positive relationships emerged between SDG Goals and People (0.175), Prosperity (0.588), Planet (0.222), and Partnership (0.073). Notably, the correlation between Peace and SDG Goals (H10) had a p-value of 0.271, exceeding 0.05, indicating no statistical significance; this was the only unsupported hypothesis.

The t-statistics further illustrate the strength of these relationships, showing particularly high values for the connections between Entrepreneurial Activity and People (14.661), Prosperity (22.583), Planet (16.859), and Peace (18.616).

These findings from PLS-SEM analysis strongly indicate the interconnectedness of various factors influencing SDG Goals, except for the Peace-SDG Goals relationship. This

thorough analysis provides valuable insights into the complex dynamics involved in achieving sustainable development objectives.

Table 4

Hypothesis testing

H	Hypothesis	Original Sample	Mean Sample	Standard Deviation	T-Statistics	p-Value	Test
H1	Entrepreneurial Activity -> People	-0.439	-0.439	0.030	14.661	0.000	Supported
H2	Entrepreneurial Activity -> Prosperity	-0.530	-0.530	0.023	22.583	0.000	Supported
H3	Entrepreneurial Activity -> Planet	-0.392	-0.394	0.023	16.859	0.000	Supported
H4	Entrepreneurial Activity -> Partnership	-0.201	-0.202	0.038	5.217	0.000	Supported
H5	Entrepreneurial Activity -> Peace	-0.449	-0.453	0.024	18.616	0.000	Supported
H6	People -> SDG Goals	0.175	0.180	0.044	3.978	0.000	Supported
H7	Prosperity -> SDG Goals	0.588	0.576	0.046	12.737	0.000	Supported
H8	Planet -> SDG Goals	0.222	0.226	0.022	9.995	0.000	Supported
H9	Partnership -> SDG Goals	0.073	0.075	0.033	2.224	0.026	Supported
H10	Peace -> SDG Goals	-0.045	-0.039	0.041	1.101	0.271	Not Supported

Table 5 outlines the indirect effects identified in our PLS-SEM analysis, highlighting the relationships among Entrepreneurial Activity, the 5Ps of the SDGs, and SDG Goals. Most indirect effects are statistically significant, indicating that the 5Ps—People, Prosperity, Planet, Partnership, and Peace—function as effective mediators between Entrepreneurial Activity and SDG Goals.

Notably, the pathways from Entrepreneurial Activity through People ($p < 0.001$), Prosperity ($p < 0.001$), Planet ($p < 0.001$), and Partnership ($p < 0.05$) to SDG Goals are significant. This suggests that entrepreneurial activities indirectly influence SDG Goals via these dimensions. However, it is essential to note that not all pathways are significant; specifically, the indirect effect through the Peace dimension ($p = 0.277$) is not statistically significant, indicating that Peace does not effectively mediate the relationship between Entrepreneurial Activity and SDG Goals in our model.

Table 5

Specific Indirect Effects

H	Hypothesis	Original Sample	Mean Sample	Standard Deviation	T-Statistics	p-Value	Test
H1	Entrepreneurial Activity -> People -> SDG Goals	-0.077	-0.079	0.021	3.722	0.000	Supported
H2	Entrepreneurial Activity -> Prosperity -> SDG Goals	-0.311	-0.305	0.029	10.690	0.000	Supported
H3	Entrepreneurial Activity -> Planet -> SDG Goals	-0.087	-0.089	0.010	8.889	0.000	Supported
H4	Entrepreneurial Activity -> Partnership -> SDG Goals	-0.015	-0.015	0.007	2.080	0.038	Supported
H5	Entrepreneurial Activity -> Peace -> SDG Goals	0.020	0.017	0.019	1.087	0.277	Not Supported

The proposed research model was evaluated using Partial Least Squares Structural Equation Modeling (PLS-SEM). Figure 5 displays the initial model, while Figure 6 illustrates the refined model after testing.

Figure 6 summarizes the PLS-SEM analysis results, showcasing the refined model's relationships between entrepreneurial activity, various Sustainable Development Goals (SDGs), and key constructs: People, Prosperity, Planet, Partnership, and Peace. The path coefficients indicate the strength and direction of these relationships.

SDGs with factor loadings below 0.5 were removed during data analysis to ensure construct validity. This refinement yielded a more streamlined model, focusing on significant indicators and relationships.

Key differences between Figures 5 and 6 include:

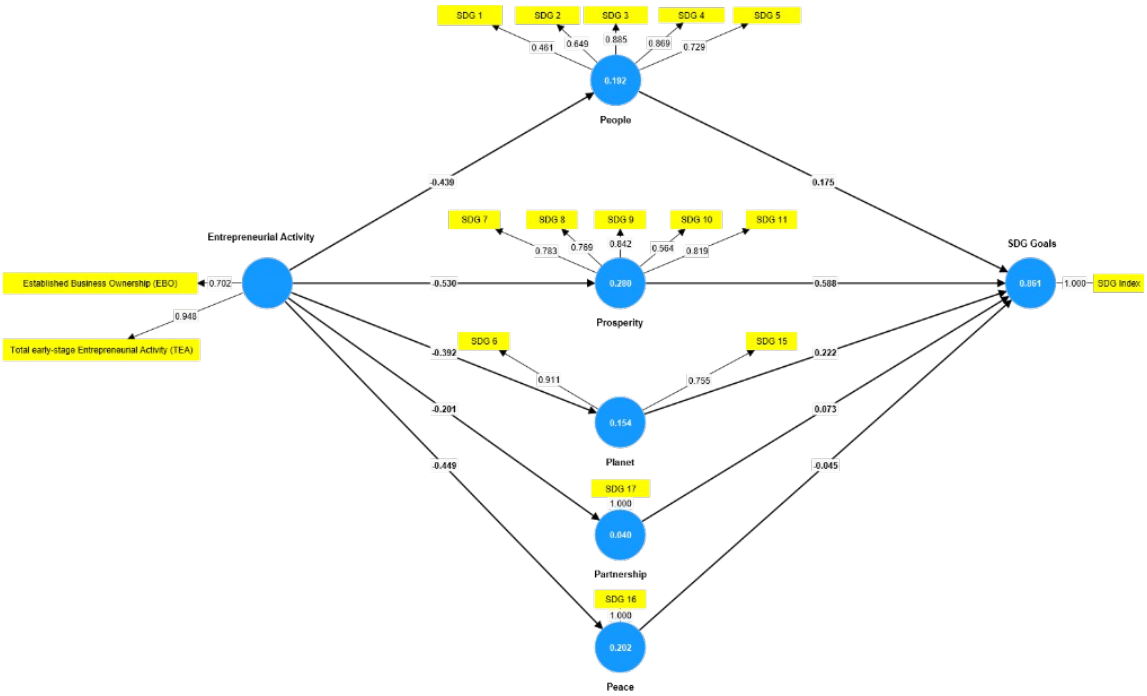
1. Elimination of low-loading SDGs: Some indicators in Figure 5 are missing in Figure 6, indicating they did not meet inclusion criteria.
2. Path coefficients: Figure 6 presents numerical values on the paths, reflecting the strength of the tested relationships.
3. Construct scores: The blue circles in Figure 6 show numerical values, likely representing latent variable scores or R-squared values for endogenous constructs.
4. Simplified structure: Figure 6 clarifies the significant relationships among entrepreneurial activity, SDGs, and the primary constructs of interest.

Comparing Figures 5 and 6, we can observe several key differences.

These findings enhance our understanding of the complex interplay between entrepreneurial activity and sustainable development goals, revealing how these factors interact in the context of people, prosperity, planet, partnership, and peace.

Figure 6

Proposed Research Model Tested



Conclusions

This study critically examines the relationship between entrepreneurial activity and the achievement of the United Nations Sustainable Development Goals (SDGs) using data from the Global Entrepreneurship Monitor and UN reports covering 96 countries from 2011-2018. The analysis reveals unexpected negative correlations between entrepreneurial activity and all five SDG dimensions: Partnership, Peace, People, Planet, and Prosperity. These findings challenge the view of entrepreneurship as a primary driver of sustainable development and instead highlight potential negative externalities associated with certain entrepreneurial activities.

Our results indicate significant negative direct effects of entrepreneurial activity on all SDG dimensions, particularly the Prosperity dimension ($\beta = -0.530$, $p < 0.001$) (Figure 6). This contradicts existing literature that positions entrepreneurship as a catalyst for economic growth and sustainable development (Audretsch et al., 2021; Naudé, 2019). Additionally, the analysis of indirect effects shows that entrepreneurial activity adversely affects SDG achievement through Prosperity ($\beta = -0.311$, $p < 0.001$), Planet ($\beta = -0.087$, $p < 0.001$), People ($\beta = -0.077$, $p < 0.001$), and Partnership ($\beta = -0.015$, $p < 0.05$), but not through Peace

($\beta = 0.020$, $p = 0.277$) (Table 5). This necessitates a more nuanced approach to promoting entrepreneurship in the context of sustainable development.

The negative correlations between entrepreneurial activity and SDGs can be theoretically justified by examining specific entrepreneurial behaviors and sectors. For example, entrepreneurial activities in extractive industries can lead to environmental degradation (SDG 13, 14, 15) and social inequalities (SDG 10) (Chofreh et al., 2021). Similarly, fast-fashion startups often prioritize rapid production over sustainable practices, exacerbating environmental issues (SDG 12, 13) and worker exploitation (SDG 8) (Niinimäki et al., 2020). Moreover, the e-commerce boom resulted in increased emissions from last-mile deliveries, negatively impacting climate action goals (SDG 13) (Shahmohammadi et al., 2020).

Interestingly, our study reveals that most SDG dimensions positively contribute to overall SDG achievement, with Prosperity showing the strongest positive effect ($\beta = 0.588$, $p < 0.001$), followed by Planet ($\beta = 0.222$, $p < 0.001$), People ($\beta = 0.175$, $p < 0.001$), and Partnership ($\beta = 0.073$, $p < 0.05$) (Table 4). However, the Peace dimension did not significantly affect overall SDG achievement ($\beta = -0.045$, $p = 0.271$). This emphasizes the interconnected nature of sustainable development goals and suggests that progress in one area can enhance others while highlighting peace's complex role in sustainable development.

In conclusion, this study significantly enhances our understanding of the interplay between entrepreneurship and sustainable development. Challenging prevailing assumptions and addressing potential negative externalities calls for reevaluating entrepreneurial practices and policies concerning the SDGs. Moving forward, it is essential to foster entrepreneurial forms that directly tackle social and environmental challenges while minimizing negative impacts, thereby aligning activities more closely with sustainable development objectives.

Discussion

This study reveals a complex and counterintuitive relationship between entrepreneurial activity and achieving Sustainable Development Goals (SDGs). Contrary to common assumptions, our analysis finds negative relationships between entrepreneurship and all five measured SDG dimensions: Partnership, Peace, People, Planet, and Prosperity. These findings challenge the conventional belief that entrepreneurship inherently benefits sustainable development, emphasizing the need for a nuanced understanding of its impacts.

Theoretical Justification for Negative Relationships

1. Environmental Degradation (Planet dimension)

   Entrepreneurial activity often negatively correlates with environmental sustainability due to startups' resource-intensive nature and cost-cutting measures that overlook ecological concerns (Muñoz & Cohen, 2017; Dean & McMullen, 2007). This issue is especially prevalent in high-activity sectors like fast fashion and extractive industries, which impose significant environmental pressures (Johnson & Schaltegger, 2020). Competitive pursuits in these fields frequently result in unsustainable production practices, exacerbating environmental degradation.

2. Social Inequalities (People dimension)

   The negative link between entrepreneurial activity and social equality arises from precarious employment in startups and the tendency for wealth concentration among a few successful ventures, which worsens income disparities (Audretsch et al., 2019). This effect is especially noticeable in "winner-takes-all" sectors like technology, where rapid resource accumulation by successful firms can widen societal gaps, challenging the view that entrepreneurship promotes inclusive economic development.

3. Economic Disparities (Prosperity dimension)

   The unexpected negative relationship between entrepreneurial activity and overall prosperity indicates a complex economic interplay. This may result from an uneven distribution of entrepreneurial benefits, prioritizing short-term gains over sustainable long-term prosperity (Johnson & Schaltegger, 2020). The focus on high-growth startups can divert resources from stable economic development, raising concerns about the effectiveness of current entrepreneurial models in promoting broad-based economic well-being.

4. Governance and Partnerships

   The intricate relationship between entrepreneurial activities and governance structures poses challenges for achieving sustainable development goals (SDGs). Disruptive ventures may undermine existing governance frameworks and partnerships by transforming industries without considering broader societal impacts. Additionally, the competitive nature of entrepreneurship can hinder the collaboration necessary for realizing SDGs, explaining the negative association with the Partnership dimension (Schaltegger et al., 2016; Mrkajic & Weerawardena, 2022). A balanced approach is needed to align entrepreneurship with sustainable development objectives and foster effective multi-stakeholder partnerships.

5. Peace and Stability

   The study found no significant correlation between entrepreneurial activity and societal peace, reflecting a complex relationship. While entrepreneurship can create economic opportunities that reduce social tensions (Boudreaux, 2007), rapid economic changes may also disrupt social structures, leading to instability (Naudé, 2010). This complexity suggests that the impact of entrepreneurship on peace and stability is context-dependent and requires further investigation to determine when it can positively influence societal harmony.

These theoretical justifications outline how entrepreneurial activity may adversely affect various SDG dimensions. However, these relationships are likely context-dependent and may differ across entrepreneurship types and socio-economic environments.

Implications and Recommendations

The findings of this study carry significant implications for policymakers, educators, and entrepreneurs, highlighting the need to align entrepreneurship with sustainability

principles to cultivate a new generation of entrepreneurs capable of promoting genuine sustainable development. We propose the following recommendations:

1. Integrate sustainability into entrepreneurship education

   Educational institutions should incorporate mandatory sustainability modules into entrepreneurship curricula, showcase successful sustainable business case studies, and adopt UNESCO's Education for Sustainable Development guidelines to equip future entrepreneurs with the necessary skills for creating environmentally and socially responsible ventures (Volkmann et al., 2021; UNESCO, 2020).
2. Implement experiential learning focused on sustainability challenges

   Institutions can implement experiential learning by partnering with local communities to identify pressing sustainability issues, encouraging students to devise entrepreneurial solutions while considering potential negative externalities, and following models like the University of Vermont's Sustainable Innovation MBA program (Molthan-Hill et al., 2020).
3. Foster partnerships between educational institutions and sustainable businesses

   Building partnerships between educational institutions and sustainable businesses is vital for promoting sustainable entrepreneurship education. This can be achieved through strategies like establishing internships in companies with strong sustainability practices, inviting sustainable entrepreneurs as guest speakers and mentors, and fostering long-term collaborations for research and innovation.
4. Enact policy measures to incentivize sustainable entrepreneurship

   Governments can encourage sustainable entrepreneurship through policies such as tax incentives for businesses meeting sustainability criteria, establishing green business incubators and accelerators focused on SDG-aligned ventures, and creating regulatory frameworks that promote sustainable practices while deterring harmful ones.
5. Enhance monitoring and evaluation of entrepreneurial impacts

   To improve the assessment of entrepreneurial impacts on sustainable development, a comprehensive approach is needed. This includes developing metrics to evaluate the social and environmental effects of new ventures, implementing mandatory sustainability impact assessments for startups seeking public funding, and establishing regular reporting measures for businesses to track their contributions to the Sustainable Development Goals (SDGs). These strategies aim to provide a holistic understanding of the broader societal and environmental implications of entrepreneurial activities, fostering accountability and encouraging sustainable business practices.

Limitations and Future Research Directions

Limitations

This study offers insights into the relationship between entrepreneurial activity and Sustainable Development Goals (SDGs) but faces several limitations:

1. Data Constraints: The Global Entrepreneurship Monitor (GEM) database has collected Entrepreneurial Employee Activity data only since 2011. The COVID-19

pandemic disrupted data collection from 2019 to 2022, making 2018 the latest year with comprehensive data for many countries.

2. Temporal Constraints: Findings are based on data from 2011-2018, limiting their applicability to post-pandemic scenarios and potentially overlooking significant changes in entrepreneurial activities and their effects on SDGs.
3. Inconsistent SDG Data: Data availability and consistency for all 17 SDGs vary by country, complicating comparative analyses and possibly introducing bias.
4. Broad Geographical Scope: Although encompassing 96 countries, the study does not analyze data by geographic regions or economic development levels, which may obscure important contextual nuances.
5. Limited Analysis of Non-Significant Findings: The implications of non-significant findings, such as the relationship between Peace and SDG goals, are not sufficiently elaborated, hindering a complete understanding of the complex relationships between entrepreneurship and specific SDGs.

Future Research Directions

To address these limitations and enhance our understanding of the interplay between entrepreneurial activity and sustainable development, we recommend:

1. Longitudinal Studies: Conduct studies that track the evolving nature of entrepreneurial activities and their long-term impacts on SDGs, particularly post-COVID-19, using more recent data.
2. Standardized Data Collection: Establish comprehensive, standardized methods for collecting data on entrepreneurial activities and SDG indicators to improve comparability across countries and regions.
3. Disaggregated Analysis: Analyze data by continent, economic region, or SDG achievement levels to reveal context-specific relationships, as supported by Venâncio and Pinto (2020)
4. Qualitative Research: Investigate qualitative aspects of entrepreneurship that positively affect SDGs through case studies or mixed-methods approaches, particularly where quantitative analyses show non-significant results.
5. Policy Framework Analysis: Explore how policy frameworks mediate the relationship between entrepreneurship and SDG achievement, focusing on effective interventions.
6. Regional Variations: Examine geographical differences in the impact of entrepreneurship on sustainable development, as indicated by Silva et al. (2022), who found varying influences of the Gini coefficient on entrepreneurship in different regions.
7. Development Stage Analysis: Further investigate how entrepreneurship's impact on sustainable development varies between developed and developing countries, building on the works of Acs et al. (2008) and Dhahri and Omri (2018)
8. Context-Dependent Studies: Conduct research considering regional characteristics that might influence the relationship between entrepreneurship and sustainable development, as suggested by Huggins and Thompson (2021).

Policy Recommendations

To align entrepreneurial activity more effectively with sustainability goals, we propose the following policy recommendations:

1. Targeted Incentives: Implement targeted financial incentives and tax breaks for entrepreneurs who demonstrate a clear commitment to addressing specific SDGs in their business models.
2. Sustainable Procurement: Develop government procurement policies prioritizing products and services from entrepreneurs who contribute positively to SDG achievement.
3. Education and Training: Integrate sustainability and SDG-focused modules into entrepreneurship education and training programs at all levels, from schools to universities and vocational institutions.
4. Sustainability Reporting: Encourage or mandate sustainability reporting for startups and small businesses, tailored to their size and capacity, to foster awareness and action towards SDGs.
5. Cross-Sector Partnerships: Facilitate partnerships between entrepreneurs, large corporations, and public sector entities to tackle SDG-related challenges collaboratively.
6. Innovation Hubs: Establish sustainability-focused innovation hubs that provide resources, mentorship, and networking opportunities for entrepreneurs working on SDG-aligned solutions.
7. Impact Investment: Develop policy frameworks that encourage impact investment in entrepreneurial ventures addressing SDGs, including mechanisms like social impact bonds.
8. Regulatory Sandboxes: Create regulatory sandboxes that allow entrepreneurs to test innovative, SDG-focused business models in a controlled environment with reduced regulatory burden.

Future studies and initiatives can provide more nuanced and actionable insights into how entrepreneurship can be leveraged as a force for sustainable development across diverse global contexts by addressing these limitations, pursuing these research directions, and implementing targeted policies.

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Phi（philomatheia）-love of knowledge

Beta (biotremmonia)-valuing of human life

Delta (diapheren)-achieving excellence