Journal of Educational Research and Policies ISSN: 2006-1137
DOI: 10.53469/jerp.2024.06(11).06

A Cultural Mind That Computes

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Abstract: ***The issue of nature vs. nurture in the field of education has enjoyed a long history of debate and discussion. In this article, we try to approach it from the perspectives of both cognitive neuroscience and developmental psychology in the attempt of developing a new cognitive-cultural perspective of education. We argue that education is essentially a cultural practice that could be viewed as a type of information processing due to its tight connection to language and cognitive process. We also bring forth a new dual-narrative framework that has the potential of explaining cultural phenomena related to issues faced in compatibility and identity development, both of which in our opinion are quite urgent matters that need to be addressed and discussed more in education.***

Keywords: Nature, Nurture, Education, Theory of Mind, Cognition, Culture, Narrative, Self-identity, Cognitive-cultural framework, Metaphor.

1. Introduction

"The phrase 'Nature and Nurture' is a convenient jungle of words, for it separates under two distinct heads the innumerable elements of which personality is composed. Nature is all that a man brings with himself into the world; nurture is every influence from without that affects him after his birth. The distinction is clear: the one produces the infant such as it actually is, including its latent faculties of growth of body and mind; the other affords the environment amid which the growth takes place, by which natural tendencies may be strengthened or thwarted, or wholly new ones implanted." - English Men of Science: Their Nature and Nurture, Francis Galton (1874/1970)

In the opening chapter of his seminal book *The Culture of Education*, Jerome Bruner listed two schools in their separate endeavor of understanding the human mind. One of them was named *Computationalism*, which sees the human mind as computers in the similar function of information processing; while the other, the *Culturalism*, views the human mind as 'cultural tools' [1]. To reflect on this picture given by Bruner under the big framework of the nature/nurture debate, this article hopes to seek a mid-way solution that may lead us to a possible synthesis. Here are our main theses.

1) Both Computationalists and Culturalists try to answer the same question "How does the mind work" from different perspectives. Therefore, if we are allowed to reframe our question by changing our focus to 'what' and asking "What does the mind work with" or "What does the mind do", there seems to be a possible mutual ground for a joint discussion-*learning*;

2) For this long and tedious Nature vs. Nurture debate, we think what's been missing so far by majority of researchers and educators is an ecological perspective that looks at and studies child development in its natural way. This in our opinion holds the potential of bringing forth an organic and synthetic solution for this seemingly unsolvable conundrum;

3) Bringing the two sets of disagreements together, we would like to propose a new cognitive perspective of education that builds upon the *Cognitive-Culture theory* [2] to unity these opinions effectively to reach a workable synthesis.

In the remaining part of this article, we will provide more details for these theses by drawing from key research findings from mainly two fields - the field of *Cognitive Neuroscience* and *Evolutionary Psychology*. We will begin by briefly booking at some of the main theories about learning since it's considered one of the key functions of the human mind.

2. A Brief Overview of Learning Theories

Ever since the ancient Greeks, the process of learning has been one of the most studied and discussed topics among scholars and philosophers. One repeatedly asked question was '*How does human learn?*' Answers to this question have been pursued by some of the most intelligent minds through the history of human civilization.

As a result, many theories have been proposed, among which we selected four influential and well-tested and proved to be effective by various practices in education. These are organized in Table 1 below according to their answer to one question - "*What is the mind?*".

Table 1: Four learning theories in a simple comparison

Answer to the question	Name of the theory and its main representor	Main tenets/claims
The mind is a black box.	Behaviorism [3], *B.F. Skinner*	Humans are no different from animals. Knowing how the mind works is not really essential for education. S-R based reward/punishment system is sufficient.
The mind is a computer.	Cognitivism [4], George Miller and Noam Chomsky	Learners are intelligent being with high-functioning minds. They are capable of doing independent thinking and intelligent activities.
The mind is an ecosystem.	Constructivism [5], Piaget and Albert Bandura	The human mind develops in a more organic and systematic approach. More specifically, it goes through distinct stages and phases.
The mind is a cultural tool.	Socioculturalism [6], Vygotsky and George Mead	The human mind prepares us in cultural setting and a more conceptual ecology. Its own development also under influence of the social and cultural context.

As you have probably noticed, different from the Behaviorist view, all other three theories agreed upon the idea that the mind plays an important role in the process of learning. We will continue by taking this claim as our basic premise as well. Then our next question comes logically would be 'How does the human mind develop and evolve?' This leads us to our next focus point: Theory of Mind.

3. *Theory of Mind (ToM)* - The Central Piece

The term 'theory-of-mind' originally came from primate studies in late 1970s [7] by a simple question - '*Do chimpanzees have mind?*'. Now after more than half century's rigorous study and fruitful development, it has become one of the core areas studied in fields of cognitive neuroscience and developmental psychology.

Theory of Mind refers to a specific mental ability of attributing one's own mental states or understandings to others. This makes it an ideal and central element to consider when talking about education.

One of the iconic tests associated with the theory is the 'Sally-Anne' False Belief test [8] that has provided great insights and inspirations to the study of human mind. According to this test and many other similar experiments done after it, children before the age of four don't have the ability to separate false beliefs from true ones. This shows us that the ability of learning true and false beliefs (as a function of the mind) is not something we born with but rather developed later on during the process of growth.

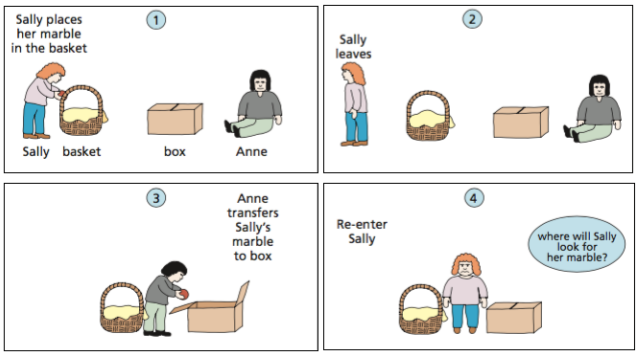

Figure 1: an illustration of the Sally-Anne False Belief test

In order to learn more about our mind and its own 'story' of development, many more studies have been conducted in this field. Some of them are also very informative in the sense of showing us more information about our mind. Due to the limitation of space, we will briefly mention three that are highly relevant to our topic.

The first study we include is the seminal work done by Henry Wellman and Liu in 2004 [9] in which they invented the progressive scale for marking different developmental stages of ToM ability. These stages include the *Diverse Desire (DD), Diverse Belief (DB), Knowledge Access (KA), False Belief (FB) and Hidden Emotion (HE). Some* follow-up studies done in the field confirmed a shared developing sequence of DD>DB>KA>FB>HE among children from most western cultural societies.

The second study was conducted on Autistic children in comparison to normally developing children [10]. As shown, children with this so-called "mind blindness" disorder couldn't pass the false-belief test even long pass the age threshold shared by the normal children.

The third study is a cross-cultural ToM developmental study done by Wellman and his colleagues in 2011 [11] aiming at further testing the validity of ToM scale in divert cultures around the world. To their surprise this time, the experiment showed that children growing up in mainland China had consistently shown a different scale sequence, DD>KA>DB>FB>HE. They then attributed this to possibly different cultural practice in Chinese society. Further cross-cultural studies showed that Chinese children were not unique in this phenomenon, similar patterns were also found in Iranian and Turkish children [12, 13].

These last findings made from cross-cultural studies demonstrated to us the hidden power played by sociocultural practice in child development and their learning process.

4. Social Learning and the Development of 'Self'

With all aforementioned findings and advancements made in the field of Theory of Mind, we are now ready to investigate our first and second theses. And the reason of grouping them together is mainly because of their tight connection with each other in the context of education. The theory we are going to introduce now this joint effort is called the '*systems-ecological development theory*' [14], proposed by Urie Bronfenbrenner in 1970s.

The system-ecological development theory divides child development into four substantial stages that are respectively termed as the micro-/meso-/exo-/macro-systems. In each stage there are featured social interactions and other elements that are also viewed and treated as self-governing sub-systems. A schematic graph is shown in Figure 2.

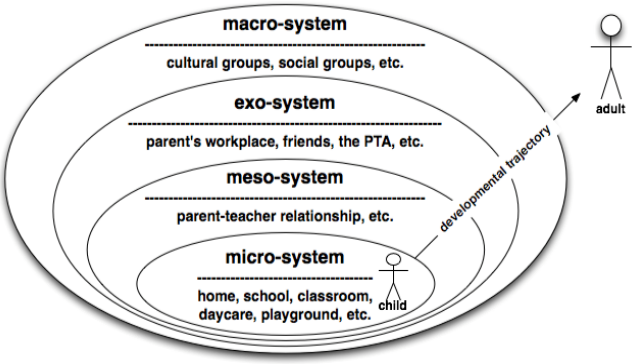

Figure 2: systems-ecological development theory

In addition, here's also a list of some stage-wise core elements from a learner's perspective companied by example questions raised from a teacher's perspective in Table 2.

Table 2: core elements and educational questions at various system levels

Level of system	Core element(s)	Example questions to ask (from educators)
Micro-systems	Organized out-of-school activities	Why are certain types of activities linked with certain developmental outcomes?
Meso-systems	Parent-teacher/tutor relationship	Do norms of school programs align with family values or school mission statements?
Exo-systems	School district policy on the availability and cost of out-of-school activity	How can activities and events be designed to overcome barriers to participation?
Macro-systems	Societal views on the importance of out-of-school activities	How could activities be tailored for targeted populations, i.e. minorities?

One may now raise questions about cultural influence upon this developmental scheme, its emergence, the potential intensity of power. To briefly address this, we will introduce two theories from the field of social sciences concerning the development of self.

As arguably the first person who have thoroughly investigated the social origin of 'self', George H. Mead in his well-known book *Mind, Self and Society* [15] offered three possible 'tools' for this complex mission: language, play, and games. According to him, a person can only develop a sense of self through his/her social interaction with others in certain forms of linguistic exchange, role play, or game play. In explaining the process of interactions, Mead used the term 'generalized other' to refer to a socially organized community that provides a member his/her unity of self within the group. Mead's account gives a valuable guide to the study of causal influence that sociocultural environment plays in the emergence of self.

Following Mead's theoretical framework, social psychologist Albert Bandura provided the crucial experimental evidence from his observations of child's social learning and behaviors. Based on these findings Bandura proposed the well-known Social Learning Theory [16] that essentially claims our social learning nature and its dependency upon outside environment (both naturally and socially) and other aspects of our life within the social context.

However, this is far from the whole story. If we try to adopt these two influential theories of social learning into explaining experiments done in ToM field, there appears a dissonance. To say the least, the social factor seems to play a rather limited role before the child getting to certain age, or for some unlucky autistic ones it might never have the powerful influence as claimed. This brings us back to the basic question of nature-nurture in learning. More specifically, it entails that learning and development depend on both one's genetic makeup and his/her social environment, thus nature together with nurture.

Moreover, there are other theories and findings made in fields like cognitive anthropology, evolutionary psychology, and developmental psychology that reveal to us other possibilities of dynamics between cultural and cognitive factors.

In remaining part of this section, we are going to briefly introduce two alternative elements in the purpose of entertaining you with some ideas of how the nature-nurture dyad might act together to influence our individual development in a socially learning environment. One of them is the decision-making related biases available in all human cultures, the other the multi-faceted personal cognitive disposition owned individually by every member of a society. These are collectively illustrated in Figure 3 on next page.

The individual centered at the left side represents an autonomous cognitive being in a social group whose general level-of-fitness can be ascribed to two categorical factors, the internal and the external well-beings. One essential goal for the individual through his/her life in the community is to increase the level of fitness by changes made to (or originated from) these two dimension. One thing need to keep in mind is that these two dimensions are not totally orthogonal, which means that they are at least correlational.

Internal factors (both physical and emotional) related well-beings are very much under the influence of external gains in the community in various forms of social resources. One good and indirect personal benefit through this process is that the beneficiary becomes a well-known successful figure among the group and it brings forth certain privileges to the person him/herself as well as to the society as a whole. For our purpose here we will only mention the issue of social coherence caused by *conformity*.

According to studies of the reasoning process from the field of cognitive psychology, we often use heuristics, a mental short-cut in doing cognitive tasks like the decision-making process. This deceptively trivial evolutionary disposition owned by our mind lends support to two pro-conformity biases, the *prestige-based bias* and *frequency-based* bias, which collectively 'nudge' members in the community to choose to follow the group 'celebrity' and to learn from him/her and in turn creates more opportunities for this person to cooperate with other group members and further increases his/her own fitness level.

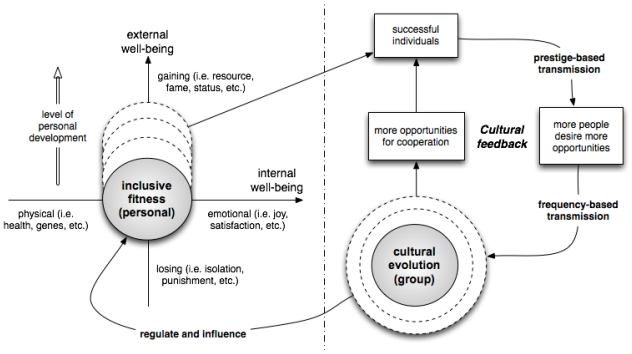

Figure 3: A working dynamic between personal disposition and collective biases

The preference described here prevails through all kinds and levels of human interactions in a society due to its foundational status. It's therefore reasonable for us to apply it to viewing teaching/learning as education is intrinsically a cooperative act among people.

Of course the actual process of education is way more complex than what we just described here, but the message we would like to convey is clear: It is through the joint work of these factors a positive feed-forward mechanism that facilitates both the individual and the social community as a whole is gradually established. And as a favorable side-effect,

it adds more ecological flavor to the standardized social learning process.

5. Culture Viewed in a New Perspective

Before moving forward to our third thesis, we think it's necessary to re-view the concept of culture through the lenses of cognitive anthropology and cognitive psychology.

Conventionally by *culture* we mean 'arts and other manifestations of human intellectual achievement regarded collectively' or 'customs, arts, social institutions, and achievements of particular nation, people, or social groups.'[17] But according to cognitive scientist and philosopher Dan Sperber, we've overlooked or at least seriously underestimated cognition as a foundational factor in our personal cultural development and should consider including it in future definition and discussions of human culture.

Sperber raised his arguments about taking into consideration of mental representations on top of the original idea of 'culture as information' mad by anthropologists Robert Boyd and Peter J. Richerson [18] More interestingly, Sperber also suggested a perspective shift when studying culture, from as a thing to as a property, in order to provide a suitable continuum that has the full potential of explaining both the fluidity and heterogeneity of culture.

Sperber's great insights shown by his proposed cognitive-cultural perspective resonates to certain extent with Friedrich Nietzsche's view of culture offered long time ago.

"culture is liberation, the removal of all the weeds, rubble and vermin that want to attack the tender buds and plants… it is the perfecting of nature." - Friedrich Nietzsche [19]

We would like to go one step further and combine them together and name it the 'dynamic cognitive-cultural view'. This is a dynamic look of culture that we would like to adopt as our new cognitive framework of education and the continuum within which cultural information flows and exchanges take place. Here's a simple graph that illustrates the dynamic process of cognitive-culture relations within a developing cultural continuum.

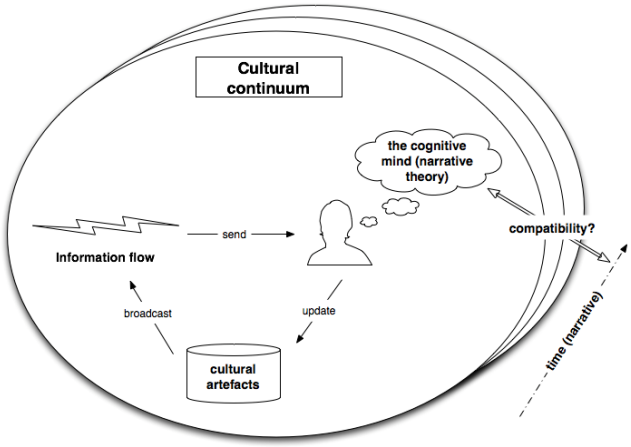

Figure 4: the cognitive-culture dynamics within a cultural continuum

As shown, the person who owns a cognitive mind possesses the ability to actively perceive and process information flowing within the cultural continuum and generate his own to enrich the collective cultural assets of the community, which then continues to 'broadcast' information flow across the community. This mutually reciprocal relationship help maintain a mechanism of 'dual-narrative' among the individual and the society.

On the personal level, the man forms his self-identity and understanding-of-life based on the cultural experience he had within the group; while on the community level, the social group itself also forms an identity that reflects its collective culture that develops over time. Another interesting part of this model is the inter-relation between the two narratives that is moderated by their level of compatibility. When the compatibility level is high, the system is harmonious and stable; whereas when it's low, there can be chaos and conflicts, which is another way to view one's fitness level when residing in a culture. If this mechanism of compatibility is expanded even broader, it can also be used to understand mismatches between proper domains and actual domains that Sperber used in his cultural theory.

One absolutely fundamental building block in this structure is the concept of informatized culture introduced by Robert Boyd and Peter J. Richerson during their amazing contribution made to the study of cultures. But some might disagree with or even challenge this rather reductionist view of culture. In our defense, the rationale behind this view lies behind the peculiarity of culture itself. Here is how it can be understood.

The word 'culture' originally came from '*agriculture*', which literally means 'to till the land, prepare it for the action of farming' [17]. In other words, the term 'culture' inherently refers to a process (with expected yields) as Sperber has argued. If we are to push this analogy one step further by comparing the human mind to a piece of 'land' while educators as practicing 'farmers' and 'gardeners' (as lots of them do really think so according to a metaphor study) in this mapping relationship, then our conclusion would be this: *the process of education is effectively a cultural process with a task of tending cultural 'lands' and a goal of yielding cultural 'products' in the similar sense of producing earthly products in agriculture*.

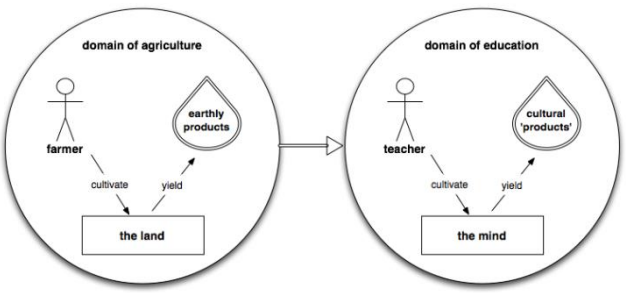

Figure 5: domain comparison between agriculture and education

So far we still have one more piece missing from the complete picture. And this last piece is hidden in human language. Conventionally when we talk about human languages it is the basic communicative function that we tend to focus on, at

times someone might view it as a symbolic system with pre-defined meanings and rigid rules to follow through. However, the situation has been dramatically changed by the promising development of cognitive science and artificial intelligence. Language is now given some new identities, including one of the core members of human intelligence and a tool for cognitive computation and conceptual manipulation. In a word, language is much more powerful and important than we used to think of it in the past. Actually this kind of revelation has long been insightfully proposed by the philosopher Heidegger, according to whom we ought to treat '*science as a language activity, the facts of language and life presupposed by scientific description of reality. The world of life as the surroundings of the operations with signs, the use of words as such, which is inseparable from the phenomenon of signification.'* [20]

What's interesting and unorthodox about Heidegger's interpretation of language is the connection he bridged between activity in real-life such like scientific work and their iconic and symbolic representations in the linguistic system, or if we are allowed to replace it by the term 'mental representations' in forms of symbols. This is almost certainly not a trivial matter of linguistic comparison or analogy as one plays with in making a speech, but rather a fundamental leap in the underneath conceptual realm.

Similarly, there are other great thinkers from other fields sharing Heidegger's view. To take an example, we will now talk about the conduit metaphor [21] which is first proposed by the linguist Michael Reddy and enjoyed the function of fundamentally changing the way we look at language and its relation to the human conceptual system.

Conduit metaphor, according to Reddy, refers to the phenomenon that language plays the role of conduit in transferring our thoughts to others. In brief words, language is seen as the 'toolbox' with all kinds of container-tools that can be used in encapsulating 'thoughts, ideas, concepts, etc.' from the speaker and then conveyed to his/her interlocutor. This creative way of connecting language with concepts has later greatly inspired Lakoff in composing his seminal book 'Metaphor We Live By' and the 'conceptual metaphor theory'. [22]

Of course the field of metaphor study is not our main concern here, but one thing we could and should make explicit and try to keep in mind as we go forth is that culture goes hand-in-hand with the human conceptual system, and the two exist and develop in a mutually dependent and influencing way. Taking the dual-narrative framework we introduced earlier, the word 'narrative' is a conceptual term that only exists in our mind. How we view and understand ourselves and the culture we live in the two narrative and their relations to each other are all purely conceptual. According to Reddy and Lakoff and their followers, language is one of if not the only available tool for us to pursuit the endeavor.

Now it's safe to conclude with a bit of certainty that language plays the conduit between education, a cultural activity, and our individual mind, where the two narratives are formed, preserved and updated in the conceptual realm. Of course this doesn't mean that we are ruling out possibilities of adopting other tools in education. It's just happen to be the case that language is 'conveniently' made available to us through our evolutionary history and development as a community with the need of learning new skills and educating our young. Once we agree upon that language plays a key role in the process of education as cultural activity, we are ready to face another challenge: Is language communication the same as information processing? Well, not exactly so according to Paul Grice's theory on linguistic communication [23].

Grice believes that human communication is not entirely based on information content but inferential in nature. Intention from a thinking mind plays the engine behind the scene and gives rise to thoughts. Linguistic utterances on the other hand are just utilized as pieces of evidence for inferring what the speaker wants his/her listeners to believe. Communication is born of mutual attributions of mental states and intention, whereas meaning is established based on 'cognitive environment'.

On its first view Grice's theory seems to contradict our developed image of language, but it really isn't so once we focus on the 'cognitive environment' mentioned by him. What does this imply? In our opinion it refers to the metalinguistic context, which undoubtedly relates to the cultural background that holds the communication. In other words, what Grice really meant is that our verbal utterances (possibly also our body language) and the cultural background work together to convey meanings. This combined message is the 'full' signal with linguistic data as information underneath. This view is totally in line with the conduit metaphor idea we mentioned earlier. What's important for us to remember is that our educational setting has already included culture a priori due to its cultural nature. This automatically adds a cultural dimension onto the language we adopt as a tool.

Hence, our suggested view of seeing linguistic communication in education as information processing does not contradict with Grice's theory. On the contrary, it provides a perfect example for Grice's idea of a 'cognitive environment'!

6. The 'Culture of Education' Revisited

Just to reflect briefly, we started our journey by mentioning Bruner's criticism of studying the human mind as computers in his book. It's good to know that Bruner also challenged the idea of treating culture as information in a later section of the book.

What we've done so far is just to try to prove that may be his assertions made in the book might need some further reconsideration when putting education in the cognitive-culture framework. In contrast, we suggest that it's better to view, understand, and treat culture as information in an educational process that is essentially a cultural activity.

Beyond the two main criticisms against the computational treatment of the human mind, Bruner has also developed a list of nine tenets addressing some of the key issues in the establishment of a sociocultural environment for education. In this section we are going to select and review some of the ones that are connected to our study from the cognitive-cultural

perspective. We hope that through this one could get a better understanding of the framework as well as some new insights for viewing education as a cultural activity. Here are Bruner's nine tenets in summary.

1) The perspectival tenet. The central claim from this tenet is to get rid of the absolute standard of right or wrong or a fixed interpretation of culture, but instead to embrace the fact that culture is always interpreted on an individual level based one's own personal while it's at the same time under influence of the collective culture.
2) The constraints tenet. According to Bruner, there are two main sources of constraints. One is the nature of human mental functioning that is shaped by our evolutionary past, the other is the symbolic system we use in our cultural activities. These two aspects can also be interpreted as the nature and nurture sides of the problem.

3) The constructivism tenet. This particular perspective believes that 'reality is made, not found' and reality construction is the product of meaning making shaped by traditions and by a culture's toolkit of ways of thinking. it also suggests to use culture as a tool in the process of education.

4) The interactional tenet. Here Bruner stressed the unique and importance of language in a highly social activity like education. He also highlighted the importance of our human ability of 'inter-subjectivity', which is closely relevant to 'Theory of Mind'.

5) The externalization tenet. This particular tenet argues for a re-evaluation of the long overlooked importance of making cultural artifacts and products in the purpose of cultural sustainability and group identity preservation.

6) The instrumentalism tenet. This particular perspective focuses on issues that concern long-term consequences of education, particularly the ones that are involved in policy making and selective choices in relation to talent and opportunity.

7) The institutional tenet. Here Bruner borrowed the ideas of market of trading and exchanging ideas from the French sociologist Pierre Bourdieu. This provides a wider perspective and context in which educational activities could be properly studied and evaluated.

8) The tenet of identity and self-esteem. With two specific issues, agency and self-esteem, Bruner introduced what we also believe to be the most important and urgent matter in our modern-day education. This is the perception of self.

9) The narrative tenet. According to Bruner, this mainly concerns choosing the correct 'subject' and adequate curriculums in school education to help nurture children's development of correct mental representations of this world they live in.

Overall we would like to say that Bruner's list of tenets is well balanced in their thorough coverage of both the constitutionally macro-level and individually micro-level of the issues within education. Yet, we are arguing that there are some points got overlooked while others redundantly mentioned when examined in the cognitive-cultural perspective we proposed earlier. Here are our reflections followed by a modified list of tenets.

First and foremost, we would like to mention the perspective issue again. We agree with Bruner in his claim of replacing an absolute value system in cultural education with a more individualized standard. That's why we are adding at the very beginning the cognitive-cultural perspective as an optimal framework which could deliver at least the following three bonus points:
1) Within the cognitive-cultural perspective we always take one's individual cognitive condition and disposition as a pre-requisite when entering the system. This entails some of the further tenets in the original list (tenet #2 and #8) and gives a better footing for the entire argument;

2) Because the cognitive-cultural perspective is originally built upon the dual-narrative theory, it's able to give equal emphasis to both the culture and individual when it comes to complicated issues like 'inter-subjectivity' and 'Theory of Mind', which is mentioned in the original tenet #4.

3) The very essence of dual-narrative theory can be summarized into three claims. a) we are living in two intertwined narratives simultaneously, one in macro-level while the other in micro-level; b) there's constant interaction between these two levels of narratives and it shapes our situated and contextualized personality and identity; c) the macro-level narrative is a manifestation of the collective identity of the cultural community that we live in. This automatically covers the original last two tenets.

Next, we would like to re-affirm here another important observation made available earlier. This is the claim that education is essentially a cultural activity. By missing this fundamental point for his list of tenets, Bruner had to frame his arguments of education in an individual-cultural 2-D system. By contrast, what we managed to do differently here is that by first providing the premise that education itself is a cultural activity, our model is able to be one dimension less than Burner's while keeping all the original functionality.

Moreover, we would like to propose for the abandonment of both tenet points #3 and #6. Here is our rationale.

1) As argued earlier in the text, that culture should be understood as a process rather than of a property. This new definition of culture is highly relevant here when re-considering the constructivist point of view. If we are adopting the idea of culture as a process and an activity, especially within the realm of education, then treating it as a tool is making a category mistake;

2) In his elaboration on tenet VI, Bruner focused on two issues in particular - talent and opportunity. We fully acknowledge them as good examples of the powerful long-term effects of education. However, if compare this with the conformity and biases model introduced earlier we think it's safe to say that education or the opportunity of taking part in education sometimes plays an end result instead of triggering factor in this complicated relationship. In another word, the directional model proclaimed by Bruner failed to stand when taking into

consideration of the cognitive factor in human decision-making. This lends another level of support to the adoption of the cognitive-cultural framework.

Lastly, we would like to argue that the last two tenets (on 'self' and 'narrative') are actually the two narratives in the dual-narrative theory within the cognitive-cultural perspective.

Let's quickly recall the dual-narrative theory again. According to this theory each of us owns a consistent and unique interpretation of the world that is compatible to our history and past experiences, while at the same time we would maintain a personal narrative about our own story and identity. Although both of them exist as conceptual representations in our mind, whenever a mismatch between them occurs, we would experience confusion and a subsequent process of adjustment will be activated automatically to help reach a new level of compatibility eventually. This process in a broad sense is called learning.

Now moving onto Bruner's last two tenets, in which he made it very clearly that self-identity is about how we perceive ourselves in a social environment while narrative in his account is all about building up a suitable (compatible) macro-level cultural environment that nurtures the individual development in the society. The whole point of building and maintaining such a narrative or cultural environment is to facilitate the development of individual's identity in order to reach the desired level of compatibility.

By carefully aligning these two groups together, we can conclude that within the cognitive-cultural perspective, the dual-narrative theory contains Bruner's last two tenets of self-identity and narrative (as a sociocultural environment), and gives them a platform to interact with each other.

Of course the compatibility issue can also be further extended to a broader social context. This can be just the case in education where multiple members perform cultural exchange activities in a community setting. One of the theories addressing this issue is the cultural compatibility theory [24]. It argues for a sufficient level of culture literacy from teachers in their daily practice in an increasingly heterogeneous and multi-cultural classroom. To our understanding, this is yet another situated reiteration of the dual-narrative theory with an emphasis on the compatibility issue.

Before wrapping everything up, we think it's necessary to quickly extend the topic of self-identity a bit considering it's perhaps the most ancient yet frequently debated philosophical question. Although it can be well traced back to the earliest Greek thinkers in history, we will follow a more modern tradition and begin with Rene Descartes, the famous French philosopher who made the well-known claim 'I think, therefore I am' [25] that later triggered serious disagreements within the scientific community with the 'mind-body' issue.

One reason for us to mention this here is to confirm our complete consent to Bruner's claim about the importance of self-understanding in education, yet we also feel very strongly that Bruner has only touched the surface of this complex issue while there are more left to be investigated if we wish to have a thorough and adequate understanding of education in the new cognitive-cultural framework. More fundamental questions like 'is there a self?', 'what defines a self?', 'where does self come from?', 'why do we need a self?', etc. should be asked and investigated. Luckily enough, we already have studies done in the fields of cognitive psychology and sociology addressing these very questions of 'what', 'why' and 'how' respectively. Here we added them as an extension to Bruner's initial claim.

Question of 'what'. Answer to this question can be found as four criteria in John R. Searle's discussion of the human mind as a whole [26]. These are the spatio-temporal continuity of body, relative temporal continuity of structure, memory, and continuity of personality. According to Searle, the 'self' gives us a sense of consistency by organizing our chaotic daily experiences in an ordered and cause-effect sequence that gives us a solid foundation to execute free will and reason about things;

Question of 'why'. Answer to this question comes from Daniel Dennett's ingenious reference to 'self as a center of narrative gravity' [27]. According to Daniel, self actually doesn't exist but only serves as an important functional role for the integrity of our own narrative. It's as important and unrealistic the same time as our sense of gravity. One other interesting point from Dennett's account is his explanation of the origin of our own narratives. He claims that our language ability 'pushes' us to create narratives involuntarily without ceasing;

Question of 'how'. In answering this question, we first go back to Mead again since he provided us a rather detailed 'recipe' on how to develop a 'self' in a social setting that equipped with tools like language, play and games. Additionally, there is a similar yet more relevant theory raised by the French philosopher Paul Ricoeur [28] that addressed the very idea of a 'narrative'. According to Paul, we collectively create a patchwork-like narrative story for ourselves as a community. This interpretation of a narrative in our opinion goes perfect in line with the dual-narrative theory we raised earlier.

To quickly sum it up, we strongly believe that the discussion of self-identity and narrative development are two absolutely utmost matters going in parallel in educational practice, especially within the cognitive-cultural framework where both the need of individual and of culture as a whole are equally attended. But unfortunately, in our modern fast-paced way of living questions about self-identity and narrative development are often missed or left to peripheral cares. We are glad that thinkers like Jerome Bruner are still keeping a record of it despite his incomplete touch.

With what we've discussed and commented above, it's now the time for us to finish this section with an updated list of tenets as a tribute to Jerome Bruner of his great contribution made in the field of education.

1) The perspectival tenet. Here we advocate explicitly that it's the cognitive-cultural perspective that we are going to adopt in our investigation of the educational practice. One important premise we would like to make clear is that education is a cultural activity, which serves as the foundation for this new perspective.

2) The dual-narrative tenet. This is where all the blending and merging of original tenets takes place. With two levels (macro and micro) of narrative interacting dynamically in the background, one develops his own understanding of the residing culture, which is the 'narrative' originally argued by Bruner in his list, while also finds him/her self-identity in that culture. Whenever mismatches or conflicts happen, a process of learning will be activated in order to reach a new balanced level of compatibility.

3) The Theory-of-Mind tenet. This serves as one of the key theories in social activities and interactions, which education with no doubt belongs to. Two of most essential and education-relevant findings made in the ToM research are that a) there are patterns of development path (or sequence) that can be observed and expected, which proves the validity of the 'nature' arguments; b) these patterns are indeed different between various cultural groups, which confirms the importance and value of the 'nurture' arguments.

4) The pragmatics tenet. This last tenet of our combines the original two tenets raised by Bruner - the externalization tenet and the institutional tenet, both of which in our opinion deal with practical issues in the actual going about of education. Based on our analysis, education itself is a matter of culture, and culture itself is a matter of active process, we think it's adequate to put both the cultural products making and educational management under the topic of pragmatics.

7. Epilogue

Instead of finishing with a 'conclusion', we've decided to go with an 'unofficial account'. This can be attributed to the following reasons.

First, this work itself is really far from finished. Rather, it marks the beginning of a new journey for us on the narrow path of truth-finding and self-searching. We are grateful for great thinkers like Bruner and researchers that made great contributions to our better understanding of humans on both individual and cultural levels. The cognitive-culture framework that we've proposed here in this study is going to continue to be tested by ourselves and others who read and comment this work, for which we give our gratitude in advance! We are certain that it needs more polishing and refinement, but we are also confident about its usefulness that is moderately testified by this study.

Second, we strongly believe that there isn't an end or finish point in discussion of culture as well as self-identity. Culture evolves all the time, and it penetrates to every aspect of our life. The same holds true for the issue of self-identity. As we have discussed thoroughly in our article that culture shapes our self and identity and vice versa. It makes us who we are in the most unique possibility of combinations. This may look a bit pessimistic or even discouraging at its first view, but we would like to highlight the fact that we've already discovered so much along the way, and it's a quite promising journey ahead.

Next, we will also leave a follow-up point to the cognitive-cultural framework. As you have probably already noticed, we mentioned metaphor studies in the development of our arguments of the special roles played by language in the process of education. This is not just an ad hoc thought or action but our actual current line of research that is already in progress. We are interested in how language is used in both its literal and figurative forms in the classroom environment by both teachers and students in real-life. We are also super interested in how the cognitive-cultural framework would function and interact during the interpretation and creation of metaphorical languages in both teaching and learning.

Lastly, we would like to quote from Bruner again as our farewell message (*Note: our added paraphrases are put in brackets).

"Education is not simply a technical business of well-managed information processing, nor even simply a matter of applying 'learning theories' to the classroom or using the rules of subject-centered 'achievement testing'. It's a complex pursuit fitting a culture to the need of its members and of fitting its members and their ways of knowing (Theory of Mind) to the needs of the culture." - The Culture of Education, Jerome Bruner [1996]

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