令和４年度
北海道大学大学院理学院

自然史科学専攻
科学コミュニケーション講座

入　学　試　験
冬　期
（外　国　語）

問　　題

○ 問題は、２ページ目から５ページ目までです。

○ 解答用紙２枚のいずれにも受験番号と氏名を書いて下さい。

○ 英和辞典（ただし電子的な辞書を除く）を参照してもかまいません。

問題１． 次の英文は、Lin Lin, J. Michael Spector (2017) “The Sciences of Learning and Instructional Design” の一部です。これを読んで、以下の設問に日本語で答えなさい。

１．下線部（A）を読み、インストラクショナルデザイン（ID）と学習科学（LS）の共通点について、日本語で説明しなさい。

２．下線部（B）を読み、2つの分野について日本語で説明しなさい。

１）インストラクショナルデザイン（ID）

２）学習科学（LS）

３．下線部（C）“Blueprints”とは何か、本文に沿って日本語で説明しなさい。

Learning Science and Instructional Design: Cousins, but Not Twins

(A)We have found it helpful to think of Learning Science (LS) and Instructional Design (ID) not as competing disciplines, but as neighboring fields of applied science in the sense of *Pasteurs Quadrant* (Stokes, 1997). Both fields are defined first by the problems they address, and they pragmatically meld partial theories from a variety of sources and epistemologies in order to tackle those problems. By contrast, a discipline is devoted to development of a single body of theory, using a defined scope of inquiry and evidence. As applied fields, we find that LS and ID share a number of defining characteristics:

- Both draw on cognitive learning theory (Donovan et al., 1999).
- Both are evidence-based and design-oriented.
- To varying degrees, both fields draw from computer science and information science, design theory, systems theory, measurement theory, economics, project management, and engineering.

(B)There is something noteworthy in each of the names of the two fields. ID is about designing instruction; the main focus is on making design decisions with the goal of building learning environments using replicable and generalizable methods. LS focuses on the science of learning. In LS, designs are proposed in order to shed light on a research question about how people could learn difficult subject matter more easily or deeply; researchers are willing to make strong assumptions to remove from consideration aspects of the problem that are not important to the scientific interest, so that the specific research question can be investigated. Thus, while both fields are applied, there is a qualitative difference: the defining focus of ID is the process of designing, while the defining focus of LS is the process of research in designed settings.

In our view, this distinction helps explain why the two fields provide complementary perspectives on applied problems. The field of ID emerged in the 1960s and had a major influence on bringing to scale the adoption of instructional design standards and practices, especially in the military, government, and in private sector training, including the use of (then-new) e-learning technologies. A considerable body of knowledge on learning environment design practices has been systematized and continues to grow rapidly. Systematic design, which started by conflating project management, analysis, and design, has more recently separated these foci and developed each separately. By contrast, LS emerged from the Cognitive Science revolution of the 1980s.The field has had a major impact on how we talk about learning: we now recognize the importance of misconceptions and can articulate a nuanced view of why they are instructionally complex to deal with. The field has also clarified issues of representation and cognition; learning is seen as social and constructive. More recently, metacognition and self-regulation are on the table for both fields. Importantly, both LS and ID see learning as trajectories of participation and not just acquisition of knowledge and skills.

（中略）

Further, both fields create overview documents to guide the design process; here we term these as Blueprints. (C)Blueprints often include an analysis of the domain to be learned, which can include documents (like the NGSS) that define learning standards. Blueprints may also include knowledge structures, learning progressions, and assessment frameworks, as well as analysis of learner characteristics (profiles). Taken together, these blueprints clarify and specify the key structural elements of the design.

Based on the foundations and blueprints, either an LS or an ID process designs new Inputs to the learning process. These can include new learning materials or resources (i.e., videos, books, podcasts), tools (i.e., simulations, interactive visualizations, data analysis tools, scientific workbenches), workspaces and learning environments, and instructor capabilities (often enhanced through professional development, coaching, and scaffolding for the teachers, coaches, mentors, parents, tutors, or other people who support the learners). Additional classes of inputs are the resources and constraints of the environment within which the learning environment must operate, such as time and place requirements, administrative policy, and organizational requirements. Each input typically has its own design tool and authoring process: thus, as an example, storyboards and templates define scripts, which are then produced using appropriate authoring tools.

※ 本文中の「NGSS」は、Next Generation Science Standards の略で、米国の学習指導要領を指す。

問題２． 以下に示したＡワインバーグによる「Science and Trans-Science」（1972）の一部を読んで、以下の問いに答えなさい。

１．下線部（A）を和訳しなさい。

２．下線部（B）“three rather different senses”が何をさしているか、英語で説明しなさい。

３．下線部（C）“In such a balance” とは何かを、日本語で説明しなさい。

４．下線部（D）を和訳しなさい。

５．この文章全体から読み取れる内容から、トランスサイエンス概念を説明しなさい。

Axiology of Science as Trans-Science:

Still a third class of trans-scientific questions constitutes what I call the axiology of science; these are questions of “scientific value” which include the problem of establishing priorities within science. These are the problems discussed under the name of criteria for scientific choice, as well as the valuation of different styles of science: pure versus applied, general versus particular, spectroscopy versus paradigm-breaking, search versus codification. All of these matters involve “scientific values” or taste rather than scientific truth. (A)In so far as value judgements—that is, ultimate questions of *why* rather than proximate questions of *what*—can never be answered within the same universe of discourse as the one in which the question arose, any resolution of these issues clearly transcends science even though the issues themselves seem to be internal to science.

It should be noted that the examples I have quoted transcend science in (B)three rather different senses. In the first case (low-level insult), science is inadequate simply because to get answers would be impractically expensive. In the second case (social sciences), science is inadequate because the subject-matter is too variable to allow rationalisation according to the strict scientific canons established within the natural sciences. And in the third case (choice in science), science is inadequate simply because the issues themselves involve moral and aesthetic judgements: they deal not with what is true but rather with what is valuable.

Trans-Science and Public Policy

Increasingly, society is required to weigh the benefits of new technology against its risks. (C)In such a balance, both scientific and trans-scientific questions must be asked by those who have the responsibility for the decisions and those who concern themselves with the decisions. The strictly scientific issues—whether, say, a rocket engine with enough thrust to support a manned moon shot can be built—can in principle be settled by the usual institutional mechanisms of science, such as debate among the experts and critical review by peers. (D)But what about the issues which go beyond science, on which the scientist has opinions which, however, do not carry the same weight as do his opinions where these are based on rigorous scientific evidence? These issues are dealt with by two institutional mechanisms: the ordinary political process and adversary procedures.

The political process, in a general sense, establishes priorities: it allocates scarce resources among alternative uses where there is no marketplace and where there is no objective or agreed norm or standard to govern the allocation. The resources to be allocated may be tangible and specific, as when a decision is made to go to the moon; or they may be much more diffuse and pervasive, as when a national commitment is made to improve the position of minorities. In either case, the resources are allocated and the priorities established by the interplay of competing political views and powers: those who want to build the SST exert what political power they have—the capacity to summon votes, to grant favours, to threaten to withdraw support; and this is resisted by those who dislike SSTs, for whatever reason. In such specific allocations of scientific resources, the scholarly discussion of science policy, dealing as it does with matters which are not internal to science, is intended to elevate and illuminate the political discussion, at whatever level this occurs. It seeks to make the contestants in the conflict more aware of the consequences of any decision and of alternatives. to show them what its implications are in terms of other values, to ensure that they weigh the costs of what they seek and that they are aware of the values which are implied in their choices.

注

low-level insult: 低レベル放射線障害

SST: supersonic transport、超音速輸送機