**Supplementary files:** *(please see the following pages)*

1. Ethics Declaration
2. Appendix

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To
The Editors
SN Social Sciences

**Sub: Declaration of IRB Exemption**
**Nagpal, Mandal & Banerjee manuscript submitted to SN Social Sciences**

Dear Editor(s),
This letter is to confirm that the manuscript entitled **"Beyond the clicks: a configurational fuzzy-set analysis of learner engagement in IIT MOOCs"** (Nagpal, Mandal, & Banerjee) does not require institutional ethical clearance under applicable human-subjects research review policies.
Study design and data sources.

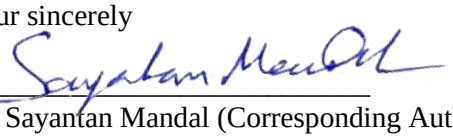
- The research uses course-level, aggregated, and archival data drawn from publicly available MOOC platforms (NPTEL and SWAYAM) and from institutional course pages.
- No identifiable personal data (names, email addresses, student ID numbers) were collected, stored, or analyzed.
- The analysis calibrated course characteristics across six dimensions (course purpose and relevance, pedagogic design, interactivity, assessment and feedback quality, teacher presence, and technical usability) at the course level; no individual learners were surveyed, interviewed, or observed.
- Where engagement measures (e.g., viewership counts) were used, only aggregate, non-identifiable metrics published by the platforms or the courses were employed.

**Applicable review guidance :** According to standard institutional review board (IRB) guidance and national research ethics frameworks, research that relies exclusively on publicly available, non-identifiable data and does not involve interaction with, or intervention on, living individuals is typically classified as exempt from human-subjects review or determined to be not human-subjects research. This work did not involve recruitment, consent procedures, collection of sensitive personal information, or any activity that would place individuals at risk.

**Data protection and confidentiality:** All data used were either publicly available or presented at an aggregated, course-level only. No attempt was made to re-identify any individual, and no individual-level datasets were created, shared, or archived. Also, data handling complied with appropriate data minimization and confidentiality practices: only project team members accessed the source materials, and no personal identifiers were recorded.

**Declaration :**
On behalf of the authors, and in accordance with the above, we declare that the research reported in the manuscript did not require prior review or approval from an institutional ethics committee or IRB because it does not constitute human-subjects research as defined by prevailing IRB policies.
Corresponding author

Your sincerely



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**Appendix**

### A.1 Vastu Shashtra, IIT Gandhinagar (3.0 out of 6)

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **0.75** | Clear disciplinary and cultural purpose; strong alignment with what became NEP 2020 goals, though predating that policy framework. Minor gaps in explicit learner outcome articulation. |
| **PD** | **0.50** | Organised thematically by topic and scholar rather than sequentially scaffolded. Each lecture functions as a relatively self-contained talk; coherence depends on the scholar rather than course-level design. |
| **IN** | **0.25** | No visible forum, quiz, or interactive mechanism in the YouTube recordings. Passive viewing format throughout; no learner-facing reflective tasks observable. |
| **AS** | **0.25** | No assessment infrastructure visible in the publicly accessible YouTube content. As a captured campus course, formal assessment presumably occurred in-person but is entirely absent from the MOOC-facing content. |
| **TE** | **0.75** | Multiple scholars, each visibly expert and articulate within their domain. Delivery ranges from compelling to conventional, but the overall impression is of genuine intellectual ownership. The rotating format, however, creates inconsistency in instructional tone across the series. |
| **TU** | **0.50** | Standard YouTube upload. Functional but not optimised; no subtitles or transcripts visible. Mobile-accessible but without any platform-level learning infrastructure. |

### A.2 Real Analysis II, IIT Palakkad (3.75 out of 6)

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **0.75** | Course purpose clearly stated: preparation for advanced mathematics, statistics, and theoretical physics. Specific prerequisite structure (Real Analysis I) signals deliberate curricular positioning. Goals are clear if implicitly stated for a specialised audience. |
| **PD** | **1.00** | 75 lectures averaging 23 minutes represent careful content decomposition. The course builds explicitly on prior knowledge in a progression consistent with advanced mathematical scaffolding. The sequential logic is tight and deliberate. |
| **IN** | **0.25** | Uploaded as a YouTube playlist with no observable interactive infrastructure. No forum, quiz, or reflective task is visible in the publicly accessible content. The format is lecture-only. |

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| **AS** | **0.25** | No assessment mechanism is observable from the public-facing YouTube content. Unlike the SWAYAM-hosted courses, this course does not appear to have a publicly accessible concurrent NPTEL MOOC assessment structure. |
| **TE** | **1.00** | Prof. Jaikrishnan's delivery is the defining quality of this course. The lectures are conducted at a blackboard, with proofs worked through in real time rather than reproduced from prepared slides. Mathematical reasoning is unpacked step by step, with a clear commitment to making the logical structure of each argument clear to the viewer — instructor presence at the upper end of the calibration scale. |
| **TU** | **0.50** | YouTube-only delivery. Functional but without subtitles, transcripts, or platform-level learning infrastructure. Adequate for the specialised audience this course targets, but not optimised for broader accessibility. |

**A.3 Engineering Graphics and Design, IIT Delhi (4.25 out of 6)**

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **0.75** | Clearly stated purpose: develop visualisation competency and graphical communication skills applicable across all engineering disciplines. Stated industry relevance is specific and credible. Minor gap in explicit week-by-week learning outcome articulation. |
| **PD** | **0.75** | 51-lecture playlist with discernible progression from foundational drawing principles through 2D representation to 3D solids. Logical sequencing observable across the YouTube content. Some variation in lecture pacing. |
| **IN** | **0.50** | Weekly assignments on SWAYAM constitute the primary interactive mechanism. No visible forum activity or peer review component in publicly accessible content. Interactivity is assignment-gated rather than dialogic. |
| **AS** | **0.75** | 12 weekly assignments, best 8 counted — a well-distributed formative structure. Assignment score carries 25% of the final grade, signalling genuine formative weight. Feedback quality not determinable from public data. |
| **TE** | **0.75** | Dual-instructor format. Both instructors are clearly visible, explain technical content competently, and demonstrate ownership of the material through worked graphical examples. Delivery is functional rather than particularly engaging; no student interaction observable. |
| **TU** | **0.75** | SWAYAM-hosted, with YouTube video delivery. Platform functional; consistent technical quality across the 51-lecture series. Subtitles not confirmed; mobile accessibility standard across SWAYAM. |

**A.4 Introduction to World Literature (4.5 out of 6)**

| Dimension | Score | Justification |
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| **CP** | **1.00** | Highly specific, explicitly stated learning goals: to develop critical reading of texts across cultural and linguistic traditions as entry points into world literatures. Directly aligned with the humanities education objectives and AICTE FDP policy goals. |
| **PD** | **0.75** | Clearly structured across 12 weeks with logical thematic progression — from classics to regional literatures, translation, contemporary writing, and critical theory. Scaffolding visible in the sequencing of texts from more familiar to more complex traditions. |
| **IN** | **0.50** | The SWAYAM platform includes weekly assignments. Forum infrastructure exists at the platform level, but its active use cannot be determined from public data. Interactivity remains primarily quiz and assignment-based rather than peer-dialogic. |
| **AS** | **0.75** | Best 8 of 12 weekly assignments counted toward the final score, building in formative regularity. Model answers or feedback mechanisms are not explicitly confirmed, but the assignment frequency represents a notably stronger formative structure than most courses in the corpus. |
| **TE** | **0.75** | Prof. Raj is a specialist in postcolonial writing and world literature whose instructional engagement with the texts is markedly above the slide-reading baseline. Visible and clearly invested, though no direct student interaction is observable. |
| **TU** | **0.75** | SWAYAM platform delivery, functional and consistent. Some limitations in mobile optimisation are reported anecdotally across SWAYAM courses, but the platform is generally accessible and structured. Subtitles not confirmed. |

**A.5 Motivation for Counting, IIT Ropar (4.75 out of 6)**

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **1.00** | The course has a clearly defined mathematical purpose: to introduce learners to counting, combinatorial reasoning, and the motivation behind formal enumeration techniques. Its learner relevance is strong because it presents mathematics not merely as procedure, but as a way of developing structured reasoning. |
| **PD** | **1.00** | The course demonstrates strong pedagogic sequencing. It appears to move from intuitive counting problems towards more formal mathematical structures, allowing learners to gradually develop abstraction. The design is scaffolded in a way that supports conceptual progression. |
| **IN** | **0.50** | Interactivity remains limited. While the course may include quizzes or problem-oriented engagement, there is little publicly visible evidence of active discussion, peer exchange, reflective tasks, or feedback loops through which learners can test and revise their reasoning dialogically. |

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| **AS** | **0.50** | Assessment appears to exist in a limited form, most likely through problem-based or quiz-based checks. However, there is no strong evidence of rich feedback, diagnostic correction, or model explanations that would help learners understand why a particular counting strategy succeeds or fails. |
| **TE** | **1.00** | Instructor presence is strong. The teaching appears to be conceptually invested, with emphasis on building mathematical intuition rather than only presenting finished formulas. The instructor's role is central in making abstract reasoning accessible to the learner. |
| **TU** | **0.75** | The course is technically functional and accessible through the public-facing platform or video infrastructure. However, its technical design does not show enough evidence of full optimisation through transcripts, subtitles, mobile-sensitive design, or integrated learner-support tools. |

**A.6 Linear Algebra, IIT Roorkee (4.75 out of 6)**

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **1.00** | The course has a highly specific and academically important purpose: to introduce learners to linear algebra as a foundational area for mathematics, engineering, data science, physics, and computational fields. Its disciplinary relevance and learner value are therefore clearly established. |
| **PD** | **0.75** | The course is logically structured and generally coherent, moving through core topics such as vectors, matrices, transformations, systems of equations, eigenvalues, and related concepts. However, the structure appears more linear than deeply scaffolded, with limited evidence of learner-specific support built into the sequence. |
| **IN** | **0.75** | The course shows some learner engagement through problem-solving orientation and assignment or quiz structures. However, interactivity remains primarily task-based rather than dialogic. There is limited visible evidence of active forums, peer learning, or reflective engagement mechanisms in the public-facing course environment. |
| **AS** | **0.50** | Assessment is present but limited in formative quality. The course likely uses problem sets, quizzes, or assignment-based checking, but these mechanisms do not visibly provide rich feedback on learner reasoning, misconceptions, or errors in conceptual understanding. |
| **TE** | **1.00** | Teacher presence is strong because the instructor visibly owns the mathematical content and explains core ideas with clarity. The delivery supports conceptual understanding, particularly where abstract linear algebraic ideas are made accessible through worked examples and structured explanation. |

**A.7 Energy Economics, IIT Mandi (5.00 out of 6)**

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **1.00** | The course has a highly specific interdisciplinary purpose, linking energy systems, economics, policy, sustainability, and development. Its relevance is clear because the course connects disciplinary knowledge to real-world questions of energy transition, markets, regulation, and public policy. |
| **PD** | **1.00** | The pedagogic design is coherent and cumulative. The course appears to move from basic economic concepts towards more complex questions of energy demand, supply, pricing, policy, and sustainability. This progression gives the course a strong internal structure and supports conceptual layering. |
| **IN** | **0.75** | The course includes some learner-facing engagement through assignments and applied policy or economics-oriented problem contexts. However, the interaction remains primarily structured through course tasks rather than through visible peer dialogue, reflective discussion, or sustained instructor-learner exchange. |
| **AS** | **0.50** | Assessment exists, but its formative quality remains limited from the public-facing evidence. The course appears to evaluate learner understanding through assignment or quiz structures, but there is insufficient evidence of detailed feedback, model reasoning, or mechanisms to identify misconceptions. |
| **TE** | **1.00** | Teacher presence is strong because the instructor's explanations appear conceptually grounded and tied to real-world energy questions. The instructor does not merely transmit definitions but helps organise the field for learners through examples, applications, and disciplinary framing. |
| **TU** | **0.75** | The technical usability is stable and consistent with the broader NPTEL/SWAYAM infrastructure. The course is accessible and functional, but the public-facing version does not provide enough evidence to assign the highest level of technical optimisation. |

**A.8 Robotics, IIT Palakkad (5.25 out of 6)**

| Dimension | Score | Justification |
|---|---|---|
| **CP** | **1.00** | The course has a highly specific applied engineering purpose: to introduce learners to robotics as a field combining mechanics, control, computation, sensing, and automation. The disciplinary relevance is explicit and strongly aligned with contemporary engineering education and skills-oriented learning. |
| **PD** | **1.00** | The course follows a strongly scaffolded structure, moving from foundational concepts to more applied robotic systems and problem contexts. The sequencing allows learners to build conceptual and technical understanding progressively rather than encountering the topic as a set of disconnected lectures. |
| **IN** | **1.00** | Compared with most courses in the corpus, Robotics offers a stronger engagement profile because of its applied orientation, problem-based examples, and platform- |

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| | | linked learner activity. The course is not merely lecture-viewing; the design creates more visible opportunities for learners to connect concepts with application. |
| **AS** | **0.50** | Assessment mechanisms are present but remain limited in their formative depth. The course appears to rely mainly on quiz or assignment-based checking, without publicly visible evidence of rich individualised feedback, diagnostic correction, or learner-specific scaffolding. |
| **TE** | **1.00** | Instructor presence is one of the strongest features of the course. The instructor appears visibly invested in the content, explains concepts with ownership, and connects technical ideas to applied robotic contexts. The delivery reflects more than slide-based transmission. |
| **TU** | **0.75** | The course benefits from stable NPTEL/SWAYAM-style technical delivery, with functional access to videos and course material. The platform is broadly accessible, though there is no conclusive public evidence of a fully optimised interface with complete subtitles, transcripts, and advanced learner-support features. |