

Architecture & STE(A)M : Investing in Community Leadership Through Early Design Education

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Architecture is a STEAM profession, and a model for education that relies on both the arts and the sciences to address the built environment, community engagement, diversity, and civic leadership. This paper provides a case study for a collaborative pedagogical model that introduces architecture, landscape architecture, and urban design in early design education as part of Rise High School's, funded after school program for underrepresented minorities. The mission of the Rise High program is to cultivate leadership in the community and an enthusiasm for science. The goal is to enable the next generation of students to attend college and pursue higher paying jobs. Working with experts from industry, and academia, students from Rise High School in Schenectady, New York, participated in an urban design proposal to design a public space in downtown Schenectady. The architecture and design module consisted of three workshops with hands on activities that introduced the students to the role of critical thinking and problem solving as they relate to design and community based leadership. All of the workshops were conducted remotely in the spring of 2021, using a combination of Zoom, Miro, and Tinkercad.

The pedagogy was developed with the guidance of three architecture faculty, six Bachelor of Architecture students and the leadership at Rise High. The selected BArch students were part of a semester long undergraduate research program (URP) initiative and received course credit while participating in the weekly planning sessions. The BArch students played a key role in collaborating with the faculty to develop the content, to prepare resources, and to troubleshoot the workshops. Each BArch mentor managed a team of seventh, eighth and ninth graders, with the support of two adult mentors. All of the workshop instruction was conducted by the BArch students while the faculty provided key lectures and observed the sessions in the remote classrooms.

“the question is not only ‘How are we to face a political problem?’ but ‘How are we to reinvent politics?’”¹

—Jacques Rancière, Politics, Identification, and Subjectivization

“One of the alternative voices in such increasing discourses around traditional and new forms of citizenships is the notion of the right to the city developed by Lefebvre (Lefebvre, 1991a, 1991b; Kofman & Labas, 1996). Lefebvre’s right to the city constitutes a radical rethinking of the purpose, definition and content of belonging to a political community. Lefebvre doesn’t define belonging to a political community in the terminology of formal citizenship status, but bases the right to the city on inhabitation. Those who inhabit the city have a right to the city. It’s earned by living in the city, and it is shared between the urban dweller and the citizen... while citizenship is guaranteed, inhabitation can be denied based on gender, disability, race, or economic status.”

—Tovi Fenster, The Right to the Gendered City: Different Formations of Belonging in Everyday Life²

INTRODUCTION

For minority student’s leadership programs offer a pathway to higher education. It was important that the architecture workshops provide an opportunity for the students to imagine themselves in the city as inhabitants, and future leaders. There are two general rights to inhabitation that are central to urban design; the *right to appropriate*, involving the full and complete use of space, and the *right to participation*, which involves the right to have a role in the decision making.^{3,4} To introduce students to design three workshops were developed to reimagine the use of a public space in Schenectady, NY. Rise High School is a community based enrichment program located in Schenectady. According to the Executive, Omayra Padilla De Jesus, “Rise High is not a mandatory school and participation is voluntary. Students are required to apply, and classes are held on Saturday mornings. By covering the cost of lunch and transportation Rise High hopes to remove these two significant barriers that limit attendance. One of the principal goals is to retain students who have demonstrated an aptitude and an attitude towards science, keeping them channeled on a path that could lead to a career in STEM, which will likely provide a good living wage, and ideally break the cycle of poverty.” Central to the pedagogy is the use of project based learning, with the school offering hands on workshops run by STEM professionals along with college students and professionals from the community who serve as mentors.



Figure 1. *Team Cube*: Rise High School, 7th, 8th & 9th graders, Design Proposals for the Franklin Gap, Schenectady, New York. A 3-day remote leadership workshop on Architecture and the Design of Public Space with the RPI School of Architecture, March, 2021. Renderings by Cate Cribb (RPI BArch '21), Kelsey Mitchell (RPI BArch '21), Anish De (RPI BArch '23), Tess Lubin (RPI BArch '21), Morgan Palmer (RPI BArch '23), and Chris Saour (RPI BArch '23).

SHARED OBJECTIVES: A SYNERGISTIC PEDAGOGY FOR COMMUNITY LEADERSHIP

Over the course of planning the architecture sessions, the team identified a number of unique learning objectives that were distributed across three design workshops. There were two groups of students involved, the Rise High middle school students (RH students), and the RPI Bachelor of Architecture students (RPI students); each had their own unique learning objectives that were strategically aligned in order to deliver the workshops. For the RH students, the first objective was to raise an awareness for the professions of architecture, urbanism, and landscape architecture. The aim of the workshops was to demonstrate that architects can take a leadership role by engaging their community through the design of public space. The architecture sessions were established to support Rise High's mission to encourage RH students the pursue a college education by working with college age mentors. It is important that the workshops introduce architecture as a career path that celebrates diversity and includes people of color. The workshops were accompanied by recorded interviews with architects whose work has impacted society, highlighting the National Museum of African American History and Culture by Sir David Adjaye, The Makoko Floating School by Silver Lion Award Winner, Kunlé Adeyemi, and the redevelopment of the High Line by James Corner and Field Operations.^{5,6,7} The aim was that the students would be inspired by these architects, and would consider pursuing a career related to the built environment. The workshops provided an opportunity to demonstrate to the students that architecture and urban design is something that can only be achieved through teamwork and participation,

rather than individuals working alone. The team also agreed that the project needed to be local in order to highlight its civic role, and that it should provide a format for the students to invest in the city and make it their own. The director of Rise High, Dr. De Jesus, invited the RPI faculty team to come to Schenectady to scout two sites near Rise High The Franklin Gap was selected as the site for the workshops. The gap connects an urban enclave of narrow parking lots within the block. The northern end opens onto city hall, making it a prime location for outdoor gatherings. It also serves as an informal urban corridor, that connects to Jay Street, an active pedestrian promenade.

Rise High's pedagogy emphasizes STEAM based learning while using science, technology, engineering, art and math, as points for guiding student inquiry, dialogue, and critical thinking. The praxis of architectural design is an excellent mechanism to demonstrate the importance of combining critical thinking and problem solving with the arts and sciences. The design challenges were configured using fundamental principles of proportion, part to whole relationships, modularity, scale and geometry. The scientific module was covered in the lectures by introducing how architects use the altitude and azimuth of the sun as a tool to critically access a design proposal. Rise High introduced CAD to the students through a previous workshop on electrical circuit design, and the architecture workshop was designed to build upon the previous CAD skills that were introduced through Tinkercad, an Autodesk platform, for 3d modeling and 3d printing. A 'Tinkercad classroom' was configured for the RH students to share and post their 3d files. The classroom interface made it possible for the mentors to enter a student's



Figure 2. *Team Hex*: Rise High School, 7th, 8th & 9th graders, Design Proposals for the Franklin Gap, Schenectady, New York. A 3-day remote leadership workshop on Architecture and the Design of Public Space with the RPI School of Architecture, March, 2021. Renderings by Cate Cribb (RPI BArch '21), Kelsey Mitchell (RPI BArch '21), Anish De (RPI BArch '23), Tess Lubin (RPI BArch '21), Morgan Palmer (RPI BArch '23), and Chris Saour (RPI BArch '23).

Tinkercad file during a remote session to provide instruction or to troubleshoot a problem. While Tinkercad has some limitations regarding units, file compatibility, and scale, its limited number of tools and the classroom setup make it useful for an introductory workshop on architecture where the students have minimal experience using 3d software. For the RPI students, it was important that they were familiar with the software and that they were able to provide instruction with Tinkercad. The RPI students also needed to be patient communicators, and capable of troubleshooting problems with the software during the remote sessions. The RPI students were participating in an Undergraduate Research Program (URP) that required them to perform a leadership role as tutors in order to satisfy the course. It was important that the RPI students develop a structure for delivering the pedagogy that would involve design, problem solving and critical thinking. To this end the RPI students played an important role in developing two sets of unique, 3d game pieces, for Tinkercad, that included a variety of urban design elements (Fig. 1,2). Finally, to deliver these goals during COVID-19 required that the entire lesson be delivered remotely using Zoom and Miro.

MODULAR PUZZLES FOR URBAN DESIGN

It was agreed that the workshop should balance imagination and invention with an awareness for the needs of the public. To achieve this two sets of game pieces were developed for the Tinkercad library (Fig. 3). The game pieces were designed to challenge the students to address form, space, and program through the assembly of the elements. The RPI students

developed two sets of pieces; a cubic set and a hexagonal set. Each set is modular, consisting of, 12", 24", and 48" elements (Fig. 3). To help the students arrange the parts, a 'game board', resembling a square grid and a hexagonal grid, was established on the site. The second objective was to encourage the students to consider the functionality of the elements for various types of outdoor activities. The elements were designed to be abstract so that the students could reconfigure them and discover new applications. To start, each student was assigned a 'L' shaped section of the alley that included a portion of the ground and a vertical portion of the lot line wall that included a window (Fig. 3). The windows provided the only constraint during the first workshop, and students were instructed to work around the openings. During the second workshop, the concept of barrier free design was introduced, and an additional constraint was added that required the students to use a ramp to negotiate any barriers at the ground plane (Fig. 2). The two constraints, one in plan and one in elevation, helped introduce a critical decision making process that demonstrated how the design process is informed by a range of geometric constraints. .

DESIGN WORKSHOPS & REMOTE LEARNING

The process of designing an architecture course for middle school students is challenging, and this was further complicated by the COVID-19 pandemic and the transition to remote learning during the planning phase. An open call was issued in the school of architecture for six student positions on the RPI team. The team consisted of three RPI faculty, three third year BArch students and three fifth year BArch students. In order to plan the workshop,

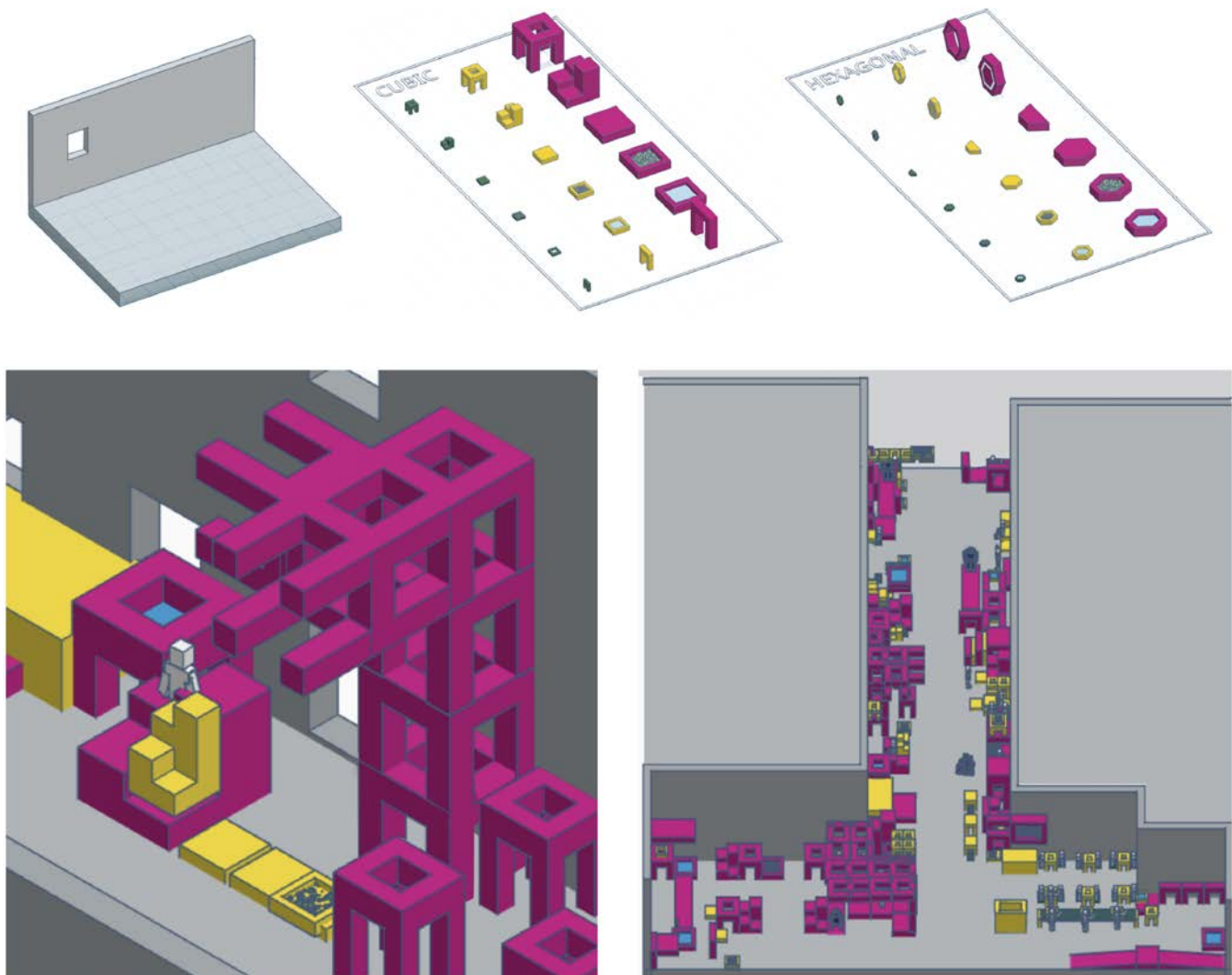


Figure 3. Top: *Workshop 1 Urban Game Pieces*: The student workspace. Two sets of eighteen elements were designed for Tinkercad. One is based upon a hexagon and one on a cube. To reinforce the application of geometry and math, each set is based on a four foot, two foot and one foot increment. March, 2021. Image: RPI team. Figure 4. Left, *Workshop 2* design work from Rise High middle schooler, M. Johnson. A design for seating, planters and a canopy. Figure 5: Right, *Team Cube's Masterplan* model prior to workshop No. 3 for the Franklin Gap Schenectady, New York, March, 2021. Image by the RPI team.

remote meetings were held once a week for eight weeks to develop the various parts of the pedagogy with the students; including the site selection, coordination of the lecture content, instruction for the design challenges, masterplan layouts, the file sharing structure in the remote classroom, coordination with the adult mentors, familiarization with Tinkercad, and the design of the game pieces and site model. Without the resources of such a large team this would not have been possible.

The architecture session consisted of three workshops. The three workshops limited the design development to two sessions and the lesson plan would have benefited from a fourth session. Each workshop was broken into two parts. The first part was a 20 minute, lecture which introduced key mathematical or scientific concepts that were central to the

design challenge. The second part of the session involved a 50 minute, Zoom breakout session where the students were doing a hands-on design challenge with their RPI student mentors. The first workshop introduced the students to several key terms and ideas; the concept of abstraction, an interview with Sir David Adjaye on the significance of architecture, an introduction to the Franklin Gap site, and a brief overview of scale and dimension. This was followed by a break out session where the students were taught how to move and assemble the game pieces. The design challenge was simple; "Select one family of game pieces and make a space by stacking and assembling the parts."

The second workshop introduced the work of Kunlé Adeyemi, and the landscape architecture and urbanism of James Corner. This was followed by a brief description of the site and its

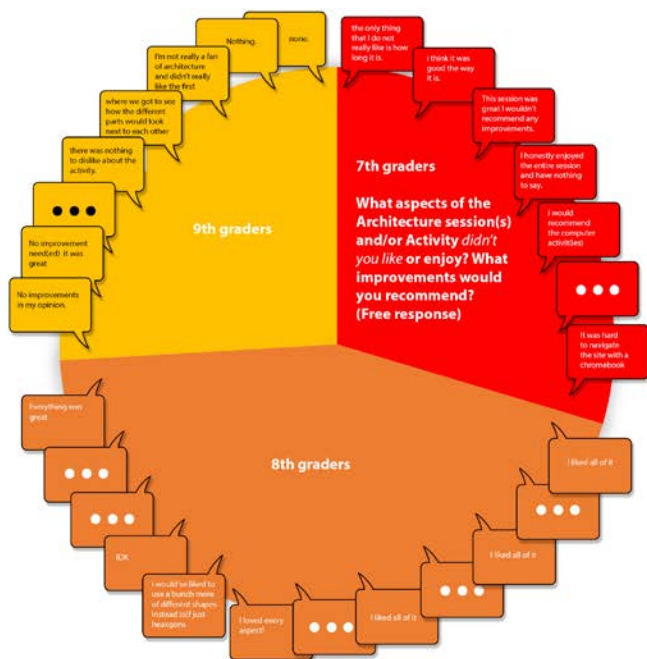
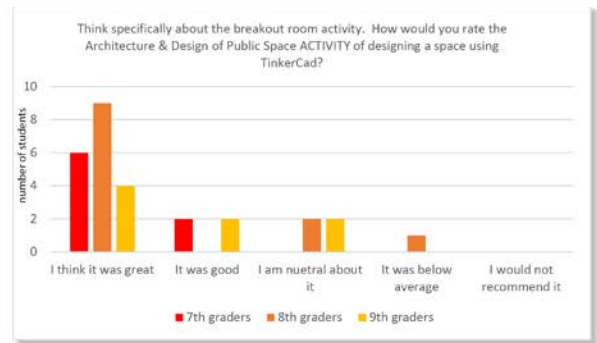
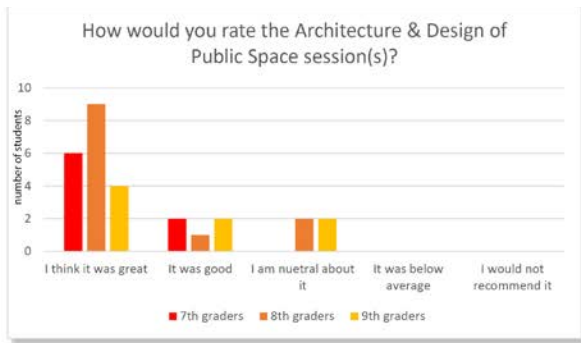


Figure 6. Top, *Curricular Content*, Rise High School, 7th, 8th & 9th graders, evaluations for the 3-day remote leadership workshop on Architecture and the Design of Public Space with the RPI School of Architecture, March, 2021. Figure 7, Bottom, *Curriculum Content*, Free Response survey. Images by Author.

solar orientation, an introduction to barrier free design, and a presentation of two case studies with unique approaches to modularity; *the VAC Library* by Farming Architects, and *Zighizaghi*, by OFL Architecture.^{6,7} These projects were instrumental in helping the students understand modular design strategies. A list of programs was assigned to the class including; planting, climbing areas, game playing, shade canopy, rest areas for pets, farmer’s market display, and seating. Each student was assigned a particular parcel and program within the masterplan (Fig. 4). The second design challenge asked; “What types of activities might transform the gap into a public space?” At the outset the team agreed that each student should have their work represented in the masterplan. This required that each student had a place to work on the site and a particular program. The students were asked to choose either the hexagonal or cubic games pieces to complete the challenge, and roughly two thirds of the students

chose the cubic set. At the conclusion of the second workshop, the RPI mentors collected all of the individual models from the students and compiled them into three Tinkercad files; one masterplan that used the hexagon pieces, and two masterplans that used the cubic pieces (Fig. 5).

The dynamics of the second workshop brought new challenges. Because there were fewer students the teams were reformulated prior to the second workshop. As a result, some students were placed on different teams, and this presented a logistical challenge to fill out all of the slots in the master plan. The Zoom breakout rooms were uniquely configured to facilitate the remote format. The Rise High adult mentors are volunteers from the community, and each breakout room had roughly two to three adult mentors, five to seven Rise High students, and one RPI student mentor. The adult mentors played a dual role as

moderators in the room while they were actively participating in the challenge themselves and sharing their screens. The adult mentors were also able to break off and assist students that encountered a technical problem or relay questions to the RPI student mentors. They inserted timely conversation about what was going on in the room, and their presence allowed the RPI mentors to focus on demonstrating the task and to adjust the pace of the instruction if it became too fast.

At the end of the second workshop it was decided that the RPI mentors would produce renderings and isometrics of each student's work prior to the final presentation and workshop 3. The hope was that by connecting the Tinkercad models to a pictorial reality, the images could serve as an interface for exchanging comments. The RPI mentors proved to be incredibly resourceful and they produced a rendering for each of the 28 of the participants (Fig. 1,2). The images elevated the discussion and they served as a resource for everyone on the team to post comments. At the start of workshop, the students met with their RPI mentors to strategize the presentation to the leadership of the city. All of the renderings were collected in a Miro board and the students were asked to provide written comments. A lengthy discussion followed with the mayor and the director of city planning regarding the proposals. The mayor and the leadership have a serious discussion about the significance of what the students had done. One of the students took the lead and asked if their design proposal was feasible. There was a very positive discussion, not only about the overall intelligence of what they had done, but the scalability of the elements and the opportunity for similar approaches to be deployed on other sites throughout the city (Fig. 1,2).

CONCLUSION

There were a number of important observations made at the conclusion of the final presentation. There were two comments that attested to the success of the workshop. The first observation was from the Director of Education at Rise High, Stacy Giordano, who said,

"I have an adage that I use in my classroom, - 'All of us are smarter than any one of us.' You proved that today. You've brought together across many institutions, your collective brains. I firmly believe in the transformative power of education. Today you had the opportunity to not only transform a space online, but the possibility to transform a space in your community. You brought your community leaders, the mayor, and the head of city planning, a reminder that kids in K-12 have brains, and thoughts, and contributions."¹⁰

One of the Rise High students, Mohamed said,

"I'm proud of this classroom. We dreamed big. We did a good job with the architecture. It looks really nice and professional, and I'm just really proud of this class."

The success of this project is a reminder that an architectural curriculum has to be flexible and nimble to embrace the opportunity to collaborate with communities, and it should be flexible enough to allow the students to lead and to initiate change for the future of our cities. RPI's undergraduate research program (URP) is a vehicle for adapting to new forms of pedagogy in a changing world. This program made it possible to combine BARCH students with different skills on the same team. The opportunity for the RPI students to be mentors allowed them to reflect upon what they have learned about architecture, and to experience firsthand how their knowledge and leadership can change the lives of others. The Rise High experience was a 'two-way' experiment – a form of synergistic pedagogical research – to orient the RH students toward excellence and a better future through early design education. At the same time, the workshops provided an opportunity to develop confidence, leadership, and maturity as an integral part of an undergraduate education.

WORKSHOP SURVEYS

Rise High ran a survey of the seventh (30%), eighth (44%), and ninth (26%) graders at the end of the workshop with 96% of the participants reporting.¹¹ Rise High typically gives two questionnaires; One related to curriculum content, and the other related to the experience, asking the students to rate them as 'Highly effective', 'Effective', 'Not effective', 'Absent'. The experience portion includes questions to gauge interest in STEM, the discovery of new things, things that they were unaware of, and the role of the mentors. Due to the pandemic, in 2021 Rise High issued only part 1 of the questionnaire related to Curriculum Content. The 7th graders ranked the architecture session, and the activity slightly more positively than the 8th and 9th graders. When asked, "How would you rate the Architecture and Design of Public Space Session?" Of the 27 respondents; 68 % of the students ranked the architecture session 'great', 18 % of the students ranked the architecture session 'good', and 14 % of the students ranked the architecture session 'adequate', 0% ranked it below average (Fig. 6). The free response questions helped to identify which aspects were popular (Fig. 7). When asked, "What aspects of the Architecture session(s) and/or Activity did you like and/or enjoy?"; 29 % mentioned building or creating the 'design', 26 % mentioned 'all of it', 22 % mentioned using 'Tinkercad', 19 % mentioned the 'realism of the renderings', 15 % used the word 'learning' in their response, 14 % used the word 'fun' or 'enjoy', 11 % entered no response. When asked, "What aspects of the Architecture session(s) and/or Activity didn't you like or enjoy? What improvements would you recommend?"; 59% were satisfied, 30% did not enter a response. There were three recommendations; one student said, 'the session was too long', one student wanted 'more shapes to work with', and one student said it was 'hard to navigate the site (model) on a Chromebook'. Overall the responses from the RH students regarding the curriculum were positive and the sessions generated enthusiasm among the participants and guests.

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